RAILROAD GAZETTE

FRIDAY, MAY 18, 1900.

CONTENTS.

Contributions.

The Southern Pacific Fire-Door.

Rocky Mount, N. C., May 8, 1900.

To the Editor of the Railroad Gazette:

The article in the Railroad Gazette, April 27, on "Burning Bituminous Coal without smoke on the Southern Pacific System" may be a little misleading. This fire-door is the original patent of the late A. J. Stevens, of which I am now the possessor, and I have improvements on it. Thinking some might consider it public property I write you.

O. A. ALEXANDER.

[Attention is called to a note on the "Bates Fire Door," published in the Railroad Gazette May 11, page 308.—Editor.]

The Southern's Operators.

Atlanta, Ga., May 13.

To the Editor of the Railroad Gazette:

In your note of May 11 on the Southern Railway telegraph operators' strike you allude to the youthfulness of the operators; and say, in effect, that if the operators had been older they would not have been so foolish as to put their fortunes in the hands of an unwise leader. While this is to some extent true, it seems to me that you ignore the significance of the small percentage of men striking. The fact that only one man out of nine left work and that some of those who did leave soon repented, is presumptive evidence that the other eight were old enough to know their own minds and to pursue a conservative course.

S. R.

Burning Soft Coal Without Smoke.

Sacramento, May 10, 1900.

To the Editor of the Railroad Gazette:

Noting Mr. Atkinson's comments in your issue of May 4 on burning bituminous coal without smoke, as practiced on the Southern Pacific, I would say that we have practiced the method of firing as described by Mr. J. Snowden Bell for the past 20 years, improving from time to time by the aid of special devices, and we are now obtaining such excellent results that we consider we are getting the highest efficiency from our fuel with no black smoke. Unless the coal used by the Canadian Pacific is of an exceptional quality, I do not understand why they should not have obtained similar results.

D. H. BAIR,
Road Foreman of Engines.

Where Should the Link of a Chain be Welded?

South Plainfield, N. J., May 9, 1900.

To the Editor of the Railroad Gazette:

Under "Engineering Tests," in your issue of May 4, page 292, commencing on the 18th line, you say: "And of careless engineering in permitting a chain to pass which was welded on the bent portion." If the links of a chain are not to be welded on the bent portion, where should they be welded? Since reading the above I have observed the links of cable chains, of car safety chains, of wrecking chains, of conveyor chains and coupling links. All are welded on the bent portion. Were they all specimens of "careless engineering?"

Is there not a mechanical difficulty in welding on the straight portion of any link? Take a coupling link for an example. Is it possible for the workman to so exactly cut his material and to do his welding to such a nicety that both sides of the link are of the same length? Whichever side of the link is the shortest will do the greater part of the work. If the welding is done at the end, the radius of the segment may be a little greater or a little less than that of the other end, but no unequal strains will be caused thereby. As the shape of a link approaches a circle these strains would lessen until in a round link there would be no straight portion on which to locate the weld.

L. E. MOLINEUX.

[The links referred to on page 292 were very large, so that specimens could be taken, which were over six inches long. The extreme ends of these included for about an inch the curved part, just as it turns away from the straight sides. From the broken specimen, it was observed that the weld did not extend around the entire end of the link, which would have insured equal or nearly equal strains on the welded part. But the weld was very short and all on that part of the bend which was included in the end of the specimen, and near the straight portion. Had the link been welded in the middle of the bend at the end, even if the weld was short, there would not have been the same danger of breaking, due to unequal strains, as when welded one side of the middle. We did not intend to recommend welding along the straight part of a link. The "careless engineering" lay in permitting a link to pass inspection, which had a short weld at one side of the middle of the end of the link.—Editor.]

Proposed Standard Specifications.

Last week we published (p. 297) certain specifications for rolled steel and wrought-iron. presented for discussion at a meeting of the American Society of Civil Engineers, May 16. Below are the remarks of Prof. Mansfield Merriman, Chairman of the American Section of the International Association for Testing Materials, in opening the discussion.

The specifications presented here this evening are the first American fruits of a wide-spread international movement which began in 1882. In that year a number of German professors, through the influence of John Bauschinger, met at Munich for the purpose of discussing means of unification of the methods of testing materials. Other conferences were held in 1884, 1886, 1888, and 1893, these being attended by engineers from several European countries and from the United States. At the fifth conference, held at Zurich in 1895, the International Association for Testing Materials was formally organized and this meeting is known as its first congress. The second congress was held at Stockholm in 1897, there being present 361 members, representing 18 countries.

The number of members of the International Association, in July, 1900, was about 1,700; of these Russia had 393, Germany, 384, Austria, 213, United States, 128, England, 87, Switzerland, 82, France, 77, Sweden, 60, Holland, 42, Denmark, 39, while about 200 others were in thirteen other countries. At the present time the membership is probably about 1,900, of which 148 are in this country.

The American Section of the International Association includes all the members living in the United States. It was organized June 15, 1898, has held two annual meetings, and the third annual meeting will take place in New York, Oct. 25 to 27, 1900. The affairs of the Association in the United States are managed by an Executive Committee of the American Section, which collects the dues of members and reports to the International Council. The American Section has established a Research and Publication Fund, to which $705 has already been contributed, and which enables it to issue bulletins containing accounts of its meetings and reports of its committees.

The technical work of the Association is carried on by international committees, of which there are now twenty-two. These committees study specific questions relating to the testing and inspection of materials, and make reports upon them to the congresses. As each committee has members in several countries the work is a slow one, but it is expected that important conclusions will be obtained for presentation to the congress which is to meet in 1901 or 1902.

Committee No. 1 has in charge the problem: "To establish international rules and specifications for testing and inspecting iron and steel." This work is to be done by harmonizing the differences that exist in the practice of different countries, but before this is possible it is plain that each country must adjust its own differences of practice and opinion. The specifications to be presented here this evening are the result of more than a year's work by the American members of the International Committee No. 1, and have been formulated after a careful consideration of the requirements now demanded by the best American practice.

The report of the American members of this committee, published in Bulletin No. 18 of the American Section, gives the history of its labors and the plans for its future work. The ten sets of specifications formulated by them are published in Bulletins Nos. 8 to 17, and three of these are to be discussed this evening. Similar discussions are to be held by other national engineering societies, and the whole subject will come up for final review at the annual meeting of the American Section in October. The committee desires, in particular, that all objections to the proposed specifications should be plainly brought forth, in order that it may be able to further modify them, if necessary, before presentation to the next Congress of the Association.

In conclusion I desire to say, that although not a member of this committee, I have had a general acquaintance with the work of the American branch since its organization in March, 1899. At that time it had but five members, who selected Mr. William R. Webster as their chairman. Through his energy, ability, and good generalship the committee has worked actively and harmoniously, collected the specifications in use, adjusted their differences, and adopted those now presented as representing, in its opinion, good American practice.

From time to time, upon his request, additions have been made to the committee until it now numbers 34, and in making these appointments it has been the aim of the Executive Committee of the American Section that producers and consumers should be equally represented. Such an increase in membership would generally add greatly to the labors of the chairman, in accordance with the law of economics that the difficulty of managing a committee increases with the square of its number. The plans of Mr. Webster, however, have been so well laid that this law seems not to have taken effect in his case. Great credit is due to him and to his committee for their efficient and successful work, and it is clear that the specifications now formulated will receive the careful consideration of American engineers.

Some Recent Work of the Keystone Bridge Co., Near Pittsburgh.

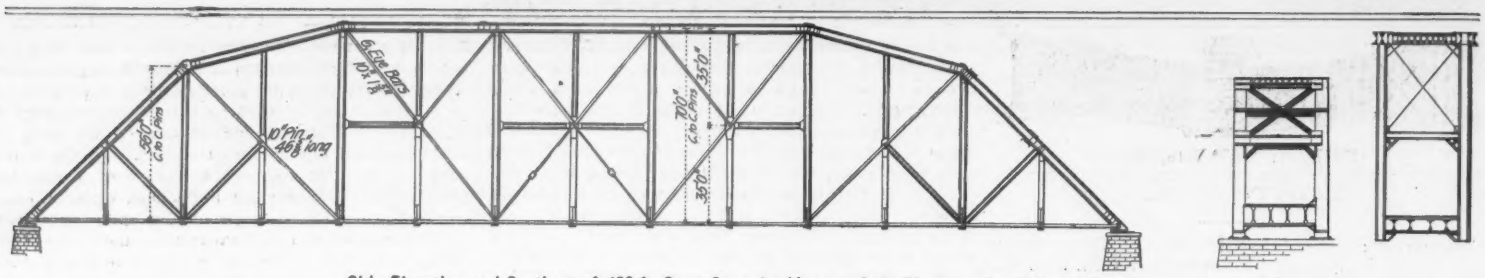
The Keystone Bridge Works Department of the Carnegie Steel Co. have, within comparatively recent time, built in and about Pittsburg a number of important bridges and viaducts. These structures are interesting, not so much from novelties of design as from the engineering features with which they are surrounded and the methods that had to be adopted in their erection.

Much of the work was done on the line of the Pittsburg, Bessemer & Lake Erie Railroad, where the work was confined to single track structures. On this work there is much in dimensions of details, and in shop and field-work that is of value and interest. This is partly due to the fact that this work had to meet so many varied and new conditions, as it was the first bridgework for carrying complete trains of cars of 100,000 lbs. capacity. The line crosses two large rivers, one of which has a traffic amounting to an annual tonnage of about five millions, carried in about seventeen thousand vessels. In addition to the tonnage there is in existence a system of handling the crafts in fleets that is suited to the swiftly rising waters. The structures were also built through boroughs and manufacturing plants and over a great number of railroads whereon there are, in all, about fifty live tracks over which there is handled about 25,000,000 tons per year, none of which traffic could be interfered with.

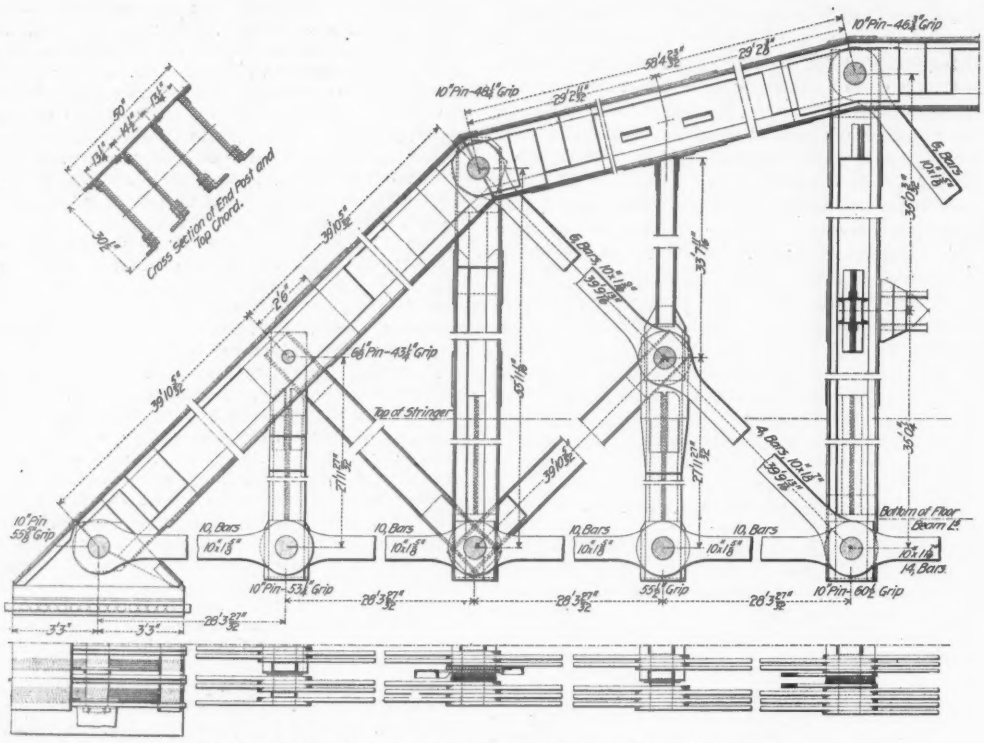
Then, when the open country was reached, the Pittsburg, Bessemer & Lake Erie traverses a rough territory. Nearly all of the viaducts were inaccessible for teaming material, and as their total length is about three miles, with a very short time available for erection, the question of erection was a governing factor in the office and shop-work. It was necessary, therefore, to procure a method that would effect the greatest saving in time and money. It was, consequently, decided to erect all of the viaducts from the rail; that is, by means of an especially designed traveler, which permitted the material to be taken directly from the railroad cars back of it, by the rear gib, to trolley it through and erect it by the front gib. Such a course necessitated not only that the material should be shipped in the order in which it was needed in the field, but also that the details should be so designed, that this method of erection could be carried out readily and effectively.

In these viaducts there were numerous special crossings, in addition to the regular towers common to such structures. There were deck and through truss spans, deck and through plate girder spans, rocker bents, railroad crossings of sharp skew, highway and street crossings, skew and square and four degree curves on some of the viaducts. The height of the towers varied from 15 ft. to 120 ft. All these, with the variation in spread of the columns in bents to suit the streets, made it necessary to deviate somewhat from the usual methods of designing and detailing in order to permit of the free use of the special traveler.

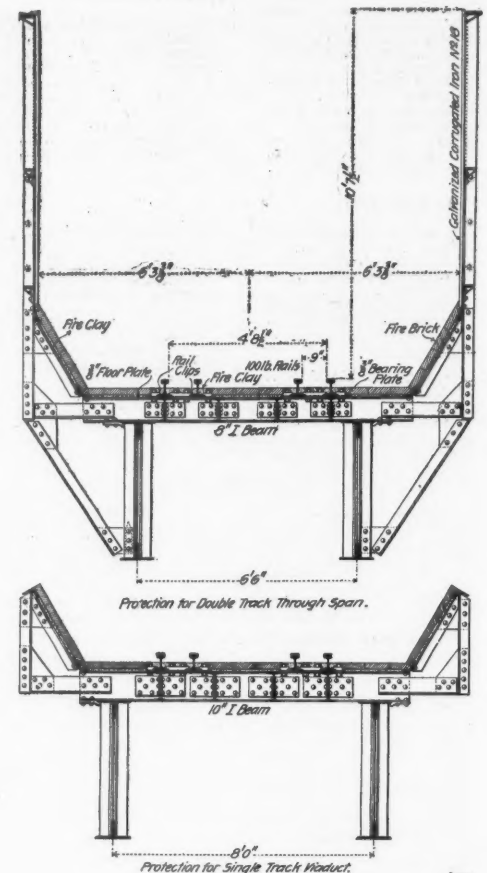
This traveler is shown, in a half-tone engraving, at work lowering one of the plate girders of the Bull Creek viaduct into position. The structure in ques-

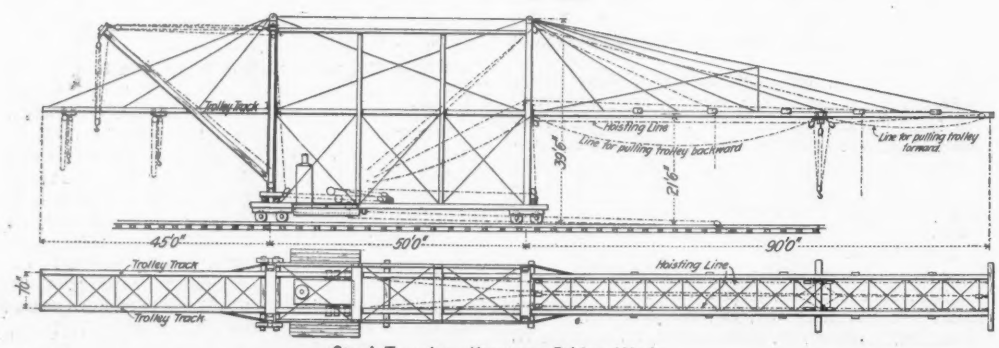


Side Elevation and Sections of 400-ft. Span Over the Monongahela River, on the Union Railroad.

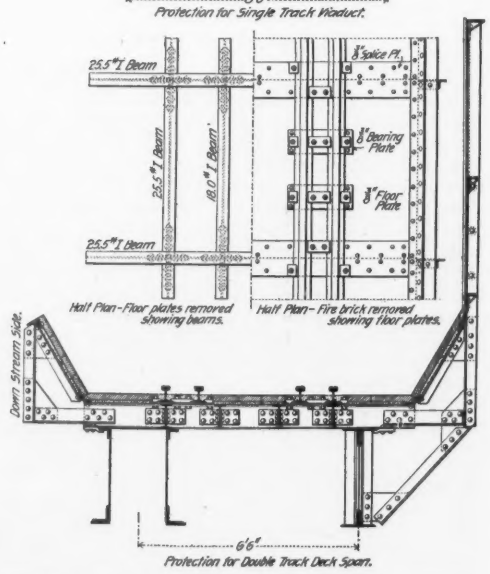


End Panels of 400-ft. Channel Span, Monongahela River Bridge, Union Railroad.

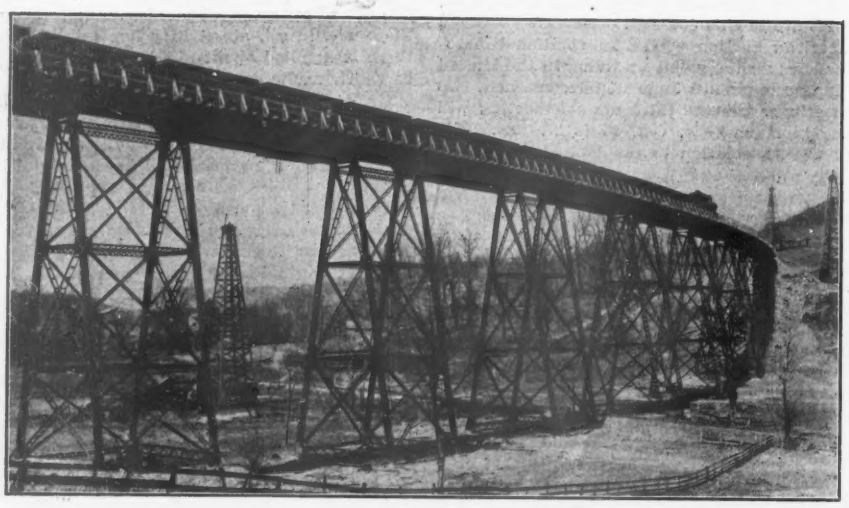




Steel Traveler—Keystone Bridge Works.



Hot Metal Protection on the Monongahela River Bridge, Union Railroad.



Bull Creek Viaduct, Pittsburg, Bessemer & Lake Erie Railroad.

tion is 1,400 ft. long and 145 ft. high, and is made up of spans of 80 ft. and 120 ft. The traveler was so made that it could be run from viaduct to viaduct over the new railroad. It could be partially dismantled and again erected, where it was necessary to pass through tunnels, of which there two on the line.

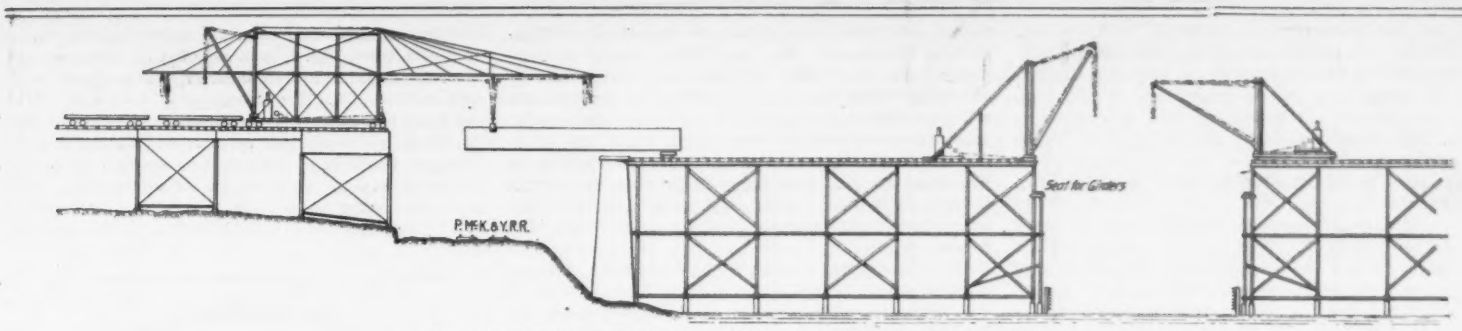
The details of the construction of this traveler are shown by the line drawings. It was carried by two bogie trucks, spaced 50 ft. between centers. On this there was a strong underframing on which the upper framing was erected. There were two trolley tracks, each formed of 12-in. channels and guyed from the tops of the corner posts. The trolley tracks were 185 ft. long and extended 90 ft. and 45 ft. front, and back of the truck centers respectively. The corner posts were formed of channels with lattice bracing. The sills of the underframing were also of the same form. Horizontal diagonal bracing, as shown in the plan, served to keep the trolley tracks in line.

The traveler was fitted with suitable hoisting engines, and its own boiler placed near the inner end of the frame so as to serve as a counterweight for a girder when suspended from the long over-hang in front. In addition to the trolley tracks there were two swinging booms footed at the back corner posts. These were used for handling material that was to be deposited at points not reached by the trolley.

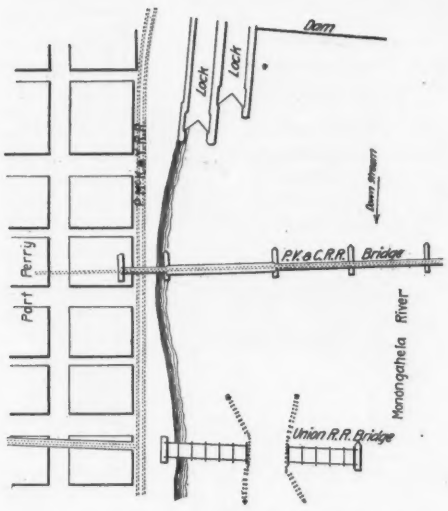
The trolley itself was fitted with 10-ton differential chain-blocks, by means of which the material was unloaded from the railroad cars and carried to the front end of the trolley tracks.

The forward movement of the traveler, while erecting, was made by its own hoisting engine and tackle, but between the structures the movement was made with a locomotive. The work was successfully carried out, as planned, without a single mishap and at a greatly reduced cost for raising the steel in the structures.

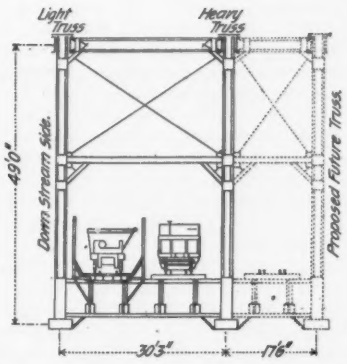
Other special devices were also employed in erection. Among these were the arrangements for lowering the vertical and inclined posts of the spans into position on the masonry. The method adopted is clearly shown by the engravings. It consisted of building a cribwork or erecting a bent, across which two beams were laid. These carried saddles, provided with nuts, through which heavy screws were run. Stirrups were attached to the latter, by which the posts were suspended as they were lowered into place. This arrangement was especially designed for use on the Union Railroad crossing of the main



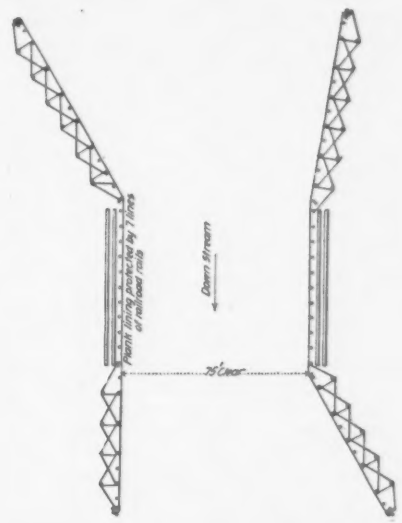
Channel Opening, Monongahela River Bridge, Union RR.—Placing 90-ft. Girders.



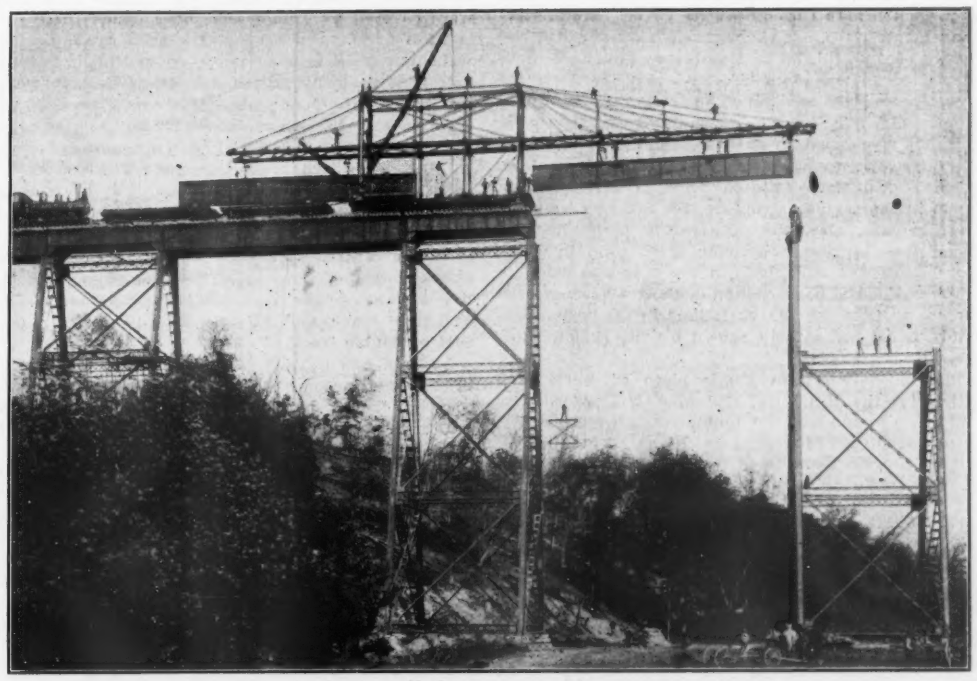
Channel Span, Monongahela River Bridge.



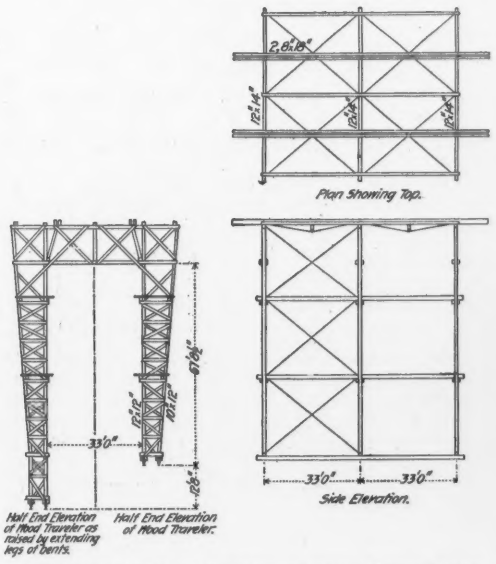
Monongahela River Bridge, Union RR.—Hot Metal Protection



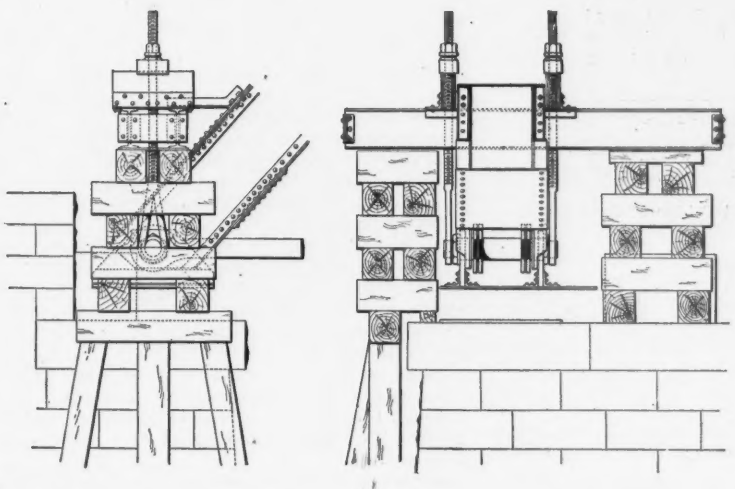
Plan of Piling of False Work.



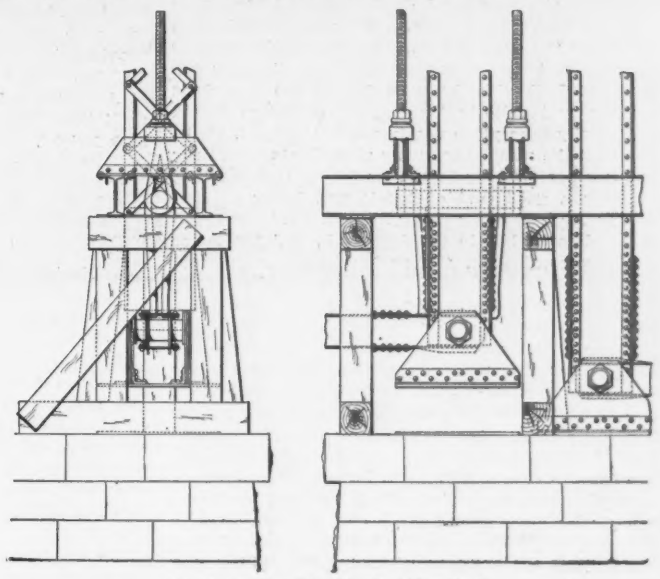
Placing a Girder—Bull Creek Viaduct, Pittsburg, Bessemer & Lake Erie.



Elevations and Plan of Traveler—Keystone Bridge Works.



Device for Lowering Inclined End Posts into Position.



Device for Lowering Vertical End Posts.

Union Railroad Bridge, Designed and Erected by the Keystone Bridge Works.

lines of the Pennsylvania Railroad at Bessemer, where there is a 182-foot double-track through span.

The traffic of the Pennsylvania Railroad at that point is great, and the passenger trains run fast, while the difference in grades adopted was the minimum. The structure erected at this point had to be exceptionally rigid. The floor was made as shallow as first-class construction and rigidity would permit. As there was no room for falsework under the bridge at its proper level; as the Pennsylvania Railroad would not slacken the speed of their trains; as the road had a sharp curve alongside a steep hill, and as the Union Railroad crossed at an angle, it became necessary to build the falsework so as to form regular tunnels over the Pennsylvania tracks, spreading some of them for the bents. It was also necessary to build a tight floor so as to prevent anything from falling on passing trains. The new bridge was then erected several feet higher than its final level, and the special device described above used for lowering it into position after completion. The same apparatus was afterward used elsewhere.

The largest structure built for the Pittsburg, Bessemer & Lake Erie RR. was the single track bridge across the Allegheny River. It consists of three deck spans of 350 ft. each, one of 520 ft., one of 210 ft. and a deck plate girder span of 25 ft., having a total weight of 2,750 tons.

The truss spans of this bridge were erected in the ordinary manner, with a wooden through traveler on falsework, as shown in the engraving. This traveler and falsework are the two most interesting features about this bridge. They were both planned with the intention of using them on the Monongahela River bridge as well. But, the latter being double track and the several spans in the two bridges being of different depths, it was necessary to construct both the traveler and falsework in such a manner that they could be widened or narrowed, lengthened or shortened, as the spans and bridges required, with a minimum expenditure of time and money.

The second matter of interest is due to the efforts of the contractors to economize in falsework and height of lifts, for the Allegheny River bridge, which is a deck bridge throughout its entire length. Arrangements were made for transporting the material for the second, third, and fourth spans over a temporary floor in the plane of the lower chord on the spans previously erected. The temporary floor was supported partly by the lower chord and partly by the rods suspended from the regular floor above, as the falsework was removed to the span being raised.

This feature necessitated some provisions being made in the regular structure, for taking care of it. In this case, also, the preparatory plans justified themselves by the extremely short time in which this bridge was built, both in the shop and field.

The method of construction of the traveler and the means adopted for the variations in dimensions already noted are clearly shown by the skeleton engraving.

The most important single piece of work done either for the Pittsburg, Bessemer & Lake Erie or Union Railroads was the double track bridge for the latter over the Monongahela River. This bridge, with a proviso for a third track, consists of one 400 ft. through span, one 250 ft. through span, three 180 ft. deck spans and one 150 ft. deck span with a metal floor for fire-proofing one track. The total weight is 3,400 tons.

There are some features of the bridge such as the proviso for a third track and the fire-proofing of one for a hot metal route, but the greatest interest centers in the erection of the 400 ft. channel span. All of the traffic of the Monongahela River passes beneath it, and directly above it are the two locks of dam No. 2. Since these locks are not large enough to pass a steamboat and its fleet of coal barges, as made up between the dams, a convoy must be broken up above the dam and both locks used for passing it. The coal barges are permitted, on leaving the locks, to drift with the current until the steamboat catches and collects them. This collection would necessarily take place nearly under the span, while, at about the same time, other steamboats with their empties are striving to get up to the lock, so that there is a good deal of bustle and hurry at that point. To provide for this contingency a large opening had to be left in the falsework, and the latter well protected from the onslaught of barges and steamers.

The four 90-ft. girders intended for the Union Railroad main line, as well as the hot metal route crossing the Pittsburgh, McKeesport & Youghiogheny Ry., next to the land pier of the large span, after first being erected in place to permit the steel traveler to pass on to the first part of the falsework for this large span, were taken up by the traveler and carried forward where they were used for spanning the opening in the falsework, provided for the passage of boats. Protection piling was put on either side of this opening and carried out on both sides of the span in fan-shape ending with a cluster of piles to facilitate the entrance of boats. This piling was braced with planking and finally lined with several rows of 100 pound steel rails, to prevent injury to the falsework. Although some anxious hours were passed until this large span was connected, nothing serious happened. The engravings show the appearance of the falsework and protective piling in elevation above the water level with the through steel traveler handling the 90 ft. plate girder that was afterward used to temporarily close the channel opening. The cranes at the end of the falsework are also shown. The large scale plan shows the arrangement of the protective piling and the small one the relative positions of the bridge, dam and locks.

The large through wooden traveler used on the Allegheny River bridge was also used here as well as for the remaining part of the bridge proper, the erection of which presented nothing of especial interest. The first span erected was the one of 150 ft., and the material for all of the other openings, including the large span, was carried out from that side over the spans already erected, the large span being erected last.

Probably the most interesting as well as novel feature of the bridge-work proper is to be found in the fire-proofing construction on the hot metal routes from the Edgar Thomson Steel Works to the Homestead Steel Works, and from the Duquesne Steel Works to the Homestead Works.

It was necessary to provide protection for steamboats and other craft, constantly passing under the bridge in the river beneath, and also by the viaducts; and further, for the railroad trains passing on the lines crossed by the hot metal route. It was also necessary to protect the steel in the structure, to prevent it from being cut by the molten metal, should some splash over from moving trains of hot metal ladle cars, or should a ladle upset while passing over the structure.

The method adopted for protection was a lining of firebrick on the floor and on the inclines from the floor to the sides and the use of galvanized corrugated iron for sides as fences. Of course these provisions put an additional dead load on the structures and called for the proper construction to carry them.

It will be seen from the engraving that, in making the floor, I-beams were used for ties; and that these were covered by ⅜in. plates, over which there is a layer of fireclay, upon which the brick are laid. The rails rest upon bearing plates ⅜ in. thick, and are held in position by rail clips fastened by bolts passing through the floor plates. The space between the traction and the guard rails and out to the edges of the rail clips is covered with fireclay up to the full height of the bricks beyond. The tracks are thus laid in the bottom of a trough of firebrick about 2½ ft. deep, and 12 ft. 6¾ in. wide, that is provided, in places, with a still further protection in the shape of the galvanized-iron fence that is 10 ft. 7½ in. high above the rails. The metal floor for supporting the fire-proofing weighs about 700 pounds per lineal foot of single track and about 1,200 pounds per lineal foot of double track.

Allusion has already been made to the fact that in the construction of these bridges, it was necessary to make them exceptionally heavy, that they might carry the very heavy traffic that would pass over them. In order to show something of the nature of this work a side elevation of the heavy truss of the 400 ft. channel span over the Monongahela River is given together with the details of the first two panels. This truss is intended to carry half the weight of the third track that may be added in the future and is therefore somewhat heavier than the light truss on the other side of the bridge. The end posts and top chords are formed of four webs each. The outside webs are made of two plates, each ⅝ in. thick, by 30 in. wide, and the inside of two plates, each $\frac{21}{32}$ in. thick. They are capped by a ⅝ in. plate, 50 in. wide. The pins for the connections are 10 in. by 1 in. bars in the lower chord. These few figures will give some idea of the strength that has been provided in these structures and it may be considered to be but a forerunner of what may be expected in American bridges when cars of 50 tons capacity shall have become common on all lines handling bulk freight.

Concrete Arches—II.

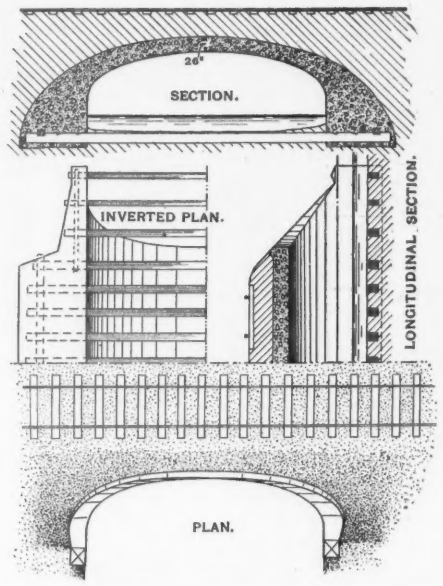
By Daniel B. Luten.*

(*Concluded from page* 308.)

Design of a Railroad Bridge of Concrete.

Let it be required to design a concrete arch of 30 ft. span, and 6 ft. rise, as shown in the preliminary sketch, Fig. 1. The height of crown above low water to be 8 ft; depth of low water, 2 feet; roadbed, above bed of stream, 15 ft.; and form of arch to be elliptical, or three centred. The arch to carry a double track railroad, with 24 ft. width of roadbed, and side slopes of one to one, with the maximum load that can be imposed by a 4-driver locomotive of 20 tons on each pair of drivers, and 8 tons on the forward truck, together with a tender weighing 36 tons.

The analysis is made for a parabolic segment with the thickness of the arch ring to vary as the secant of the angle of inclination, in order to apply the simpler method of Greene's Graphical Analysis. A parabola b a c, Fig. 2, was selected by trial, approximately parallel to the desired curve of the arch, and of span b c. The parabola is drawn by dividing the tangent at the vertex into the same number of equal parts as the vertical through any point through which it is desired the parabola shall pass, as shown at 1, 2, 3, 4, 5, on the horizontal and vertical lines; radiating lines from the vertex a to the points of division on the vertical, intersect the verticals



Design of a Railroad Bridge of Concrete—Luten.

through the horizontal divisions in points of the parabola.

Assuming the loads to be concentrated at a_0, a_1, a_2, etc, the polygons for each separate load may be drawn, the ordinates being computed according to Greene's formulas. Thus a_0, a_1, a_2, etc., are each at a height above the line b c, of one and one-fifth times the greatest rise of the parabolic segment. The ordinate at the right, as b b_0 is equal to $\frac{2}{15}\frac{1+5n}{1+n}$ k, and the ordinate at the left, as c c_0, is equal to $\frac{2}{15}\frac{1-5n}{1-n}$ k, where n is the ratio of the distance of load from the center, to the half-span, and k is the rise of the parabola at the vertex a. Thus for a load at a_0, n = o, and c c_0 = 0.″17, b b_0 = 0.″17. For a load at

a_1, n = $\frac{1}{5}$,	c c_1 = 0.″03,	b b_1 = 0.″27
a_2, n = $\frac{2}{5}$,	c c_2 = —0.″15,	b b_2 = 0.″34
a_3, n = $\frac{3}{5}$,	c c_3 = —0.″51,	b b_3 = 0.″40
a_4, n = $\frac{4}{5}$,	c c_4 = —1.″21,	b b_4 = 0.″45
a_5, n = $\frac{5}{5}$,	c c_5 = —3.″27,	b b_5 = 0.″49

The loads at the points a_0, a_1, a_2, etc., estimated for the probable depth of concrete and the roadway, at 150 lbs. per cu. ft. for concrete and 125 lbs. for earth filling, amount to 1,800 lbs. at the crown, 2,000 lbs. at a_1, at 2,300 lbs. at a_2, etc., for one foot of width of the structure.

These loads are laid off in Fig. 3 upward from e; thus the load at the crown is represented by e d_0; the stress diagram for this load may now be completed by drawing d f_0 and e f_0 parallel respectively to the sides of the moment polygon, a_0 c_0, and a_0 b_0. The horizontal distance from f_0 to the vertical d_0 e represents the horizontal thrust of the arch due to that load. In the same way the thrust occasioned by each separate load is found and the sum of all the separate horizontal components is the total horizontal thrust due to the dead load. It may be noted that the vertical reactions at each abutment due to any load are given by this same stress diagram.

The complete stress diagram for dead load may now be drawn as in Fig. 4, the vertical loads being laid off in order, the horizontal thrust laid off horizontally at the middle point since the reactions are equal. The equilibrium curve for dead load will have its sides parallel to the lines radiating from P; but first a point must be determined through which this equilibrium curve is to pass. By taking moments about c, of each of the horizontal thrusts of the separate moment polygons, which act at c_0, c_1, c_2, etc., and dividing their sum by the total horizontal thrust, the distance from c to the point of application of that total thrust is obtained and laid off at p_1 in Fig. 7. The equilibrium polygon is drawn through p_1, and is represented by the broken line passing through p_0 p_2, keeping very close to the parabola.

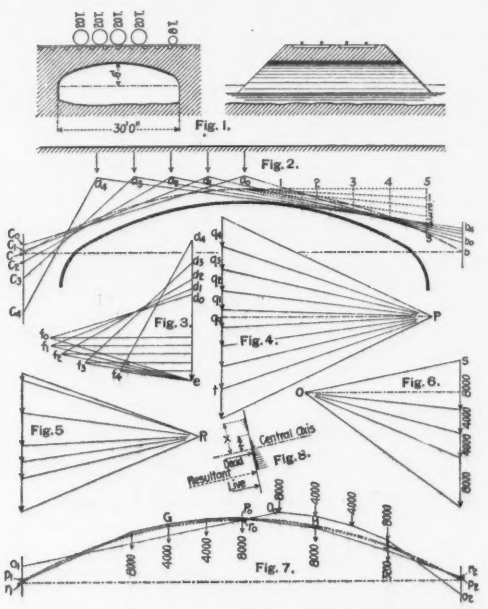
Assuming the locomotive load on each rail to be distributed over two and one-half feet in length of the structure, a very safe estimate, the load on the unit width of arch would be 8,000 lbs. at each driver. This is assumed to be concentrated at the

*Instructor in Civil Engineering, Purdue University.

point of application, another safe estimate. Thus, when the locomotive stands with second driver at a_0, the loading at a_0 will be 8,000 lbs.; at a_1, 4,000 lbs.; at a_2, 4,000 lbs.; at a_3, 8,000 lbs., etc., as shown in Fig. 7. The horizontal thrust and vertical reactions are found similarly to the method of Fig. 3, and the stress diagram drawn, see Fig. 5. The equilibrium curve for this loading is the full line r_1 r_0 r_2 of Fig. 7. The worst case, however, does not occur when the arch is fully loaded, but is found by trial to be with the locomotive, without the tender, placed on one-half of the arch only, its rear driver being about three feet from the center. The stress diagram for this arrangement of load is Fig. 6, and the equilibrium curve is o_1 o_0 o_2 in full line, of Fig. 7.

The greatest deviation from the center line of the equilibrium curves for dead load and for the latter arrangement of live load, is at G, a section of which is shown in detail in Fig. 8. The dead load stress at that point is shown by the stress diagram to be 18,000 lbs., and by the equilibrium curve is shown to be acting at a distance of 1 in. from the central axis of the parabolic segment. The live load force is 26,000 lbs., acting at a distance of 10 in. The resultant of the two is 44,000 lbs., acting at $5\frac{7}{10}$ in. from the axis.

Assuming that the stress on the section varies uniformly as the distance from the neutral axis as-



Analysis for a Parabolic Segment of a Concrete Arch.

sumed to be a distance z from the central axis, and representing the thickness of the arch ring at this section by 2x, we have, by taking moments about the center of gravity of the tensile stresses on that section $\frac{44{,}000}{12} = \frac{2}{3} f \frac{x\,(z + x)}{5.''7 + \frac{2}{3} x + \frac{1}{3} z}$, where f is the maximum fiber stress. Also, by summation of the forces on the section, $\frac{44{,}000}{12} = 2 f \frac{z\,x}{z + x}$.

Assuming f to be not greater than 300 lbs. per square inch for compression, and solving for x, and z, x is found to be 14 in.; the tensile stress is found by proportion to be not greater than 60 lbs. per square inch for that value of x, and the thickness of the arch ring at that point therefore may safely be taken as 28 in.

A similar analysis for sections at H and also at J, where the first arrangement of load produces the greatest stress, show that a depth of 28 in., is more than sufficient to satisfy the conditions existing there. Proportioning the arch ring, therefore, so that its thickness will vary as the secant of the angle of inclination of the parabola, a thickness of 26 in. at the crown is required.

The timber ties must resist the greatest possible horizontal thrust, which is found to be approximately 45,000 lbs. per foot of width. Allowing 1,500 lbs. per square inch for timber in tension, and placing the ties at 3 ft. on centers, a section of 8 x 14 in. will be required, which may be built up on 2 x 14 in. timbers, five in number, spiked together with wooden pegs. The above section will be supcient to resist the thrust in case of cracking, as may be shown by drawing the moment polygons for an arch hinged at the crown. *Be it understood, however, that the writer has no fear that such an arch properly erected will ever crack, but this safeguard is suggested for those who have doubts as to the action of concrcie under impact.*

The arch may be finished as shown in the section and plans, by extending the abutments until they intersect the side slopes, and molding a projection on the arch ring, to prevent slipping of the earth above.

The bill of materials required for the above structure is approximately 200 cu. yds. of concrete and 8,000 board feet of timber. As the pressure on the base will be less than one ton per square foot, no piling will be required for foundation. Falsework and erection are not included in the above materials.

One argument that may be urged against such a structure is the time required for it to harden, at least ten days. This need prove no obstacle to traffic, however; for, if the waterway may be narrowed, the concrete abutments may be laid against the piers of the old bridge and the concrete carried up around the members of the superstructure, which can be permitted to remain, or may be removed as desired. In other cases, the arch may be built up in sections, the wing walls first, carried up until a stringer can be thrown across to support the ends of the old bridge, when the piers may be removed and replaced by the abutments, which will in turn act as the supports while the arch ring is built in. Or the old bridge may be supported on falsework, which can afterward be used as the falsework for the arch.

Mogul Locomotive for the Great Northern Railway of England.

In our issue of January 12 last was illustrated one of the eight-wheel passenger locomotives built by the Baldwin Locomotive Works for the French State Railroads, and this engine and the mogul freight engine for the Great Northern of England, now shown, are both to be exhibited by Baldwins at the Paris Exposition.

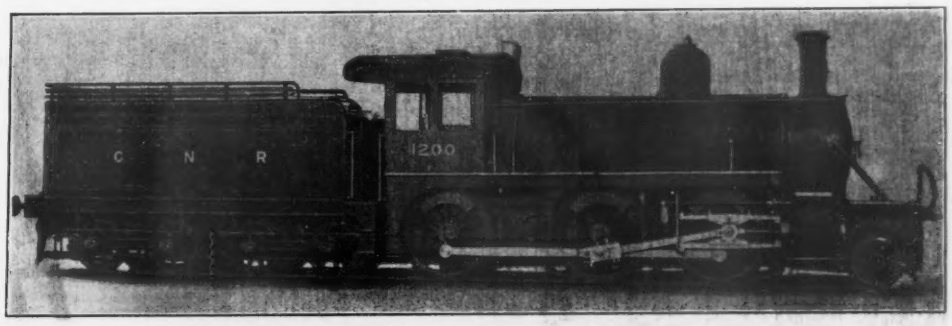
The Great Northern locomotive is built for a 4 ft. 8½ in. gage and will burn bituminous coal. The total weight in working order is 100,700 lbs., the weight on driving wheels is 85,500 lbs., the cylinders are 18 x 24 in. and the driving wheels are 61½ in. in diameter; the working steam pressure is 175 lbs. The boiler is of the straight barrel type, 54¾ in. in diameter at the front, and has 120 sq. ft. of firebox heating surface, 1,260 sq. ft. of tube heating surface, or a total of 1,380 sq. ft.; the grate area is 16.7 sq. ft. The crown sheet is stayed with inverted T irons, 6 x 5¼ in., suspended from the roof of the boiler. The firebox and back tube sheets are copper and the tubes are charcoal iron.

The tender has two four-wheel trucks and when fully loaded weighs 94,000 lbs., the weight empty being 38,300 lbs. The tank has a capacity of 4,200 gallons of water and 7 tons of coal. The length of the engine and tender over all is 51 ft. 7 in. Other dimensions are as follows:

Total wheel base of locomotive	22 ft. 8 in.
Distance between center of front and back driving wheels	14 ft. 9 in.
" from center of main driving wheels to center of cylinders	11 ft. 1 in.
Length of main connecting rod from center to center of journals	6 ft. 10 in.
Transverse distance from center to center of cylinders	6 ft. 4½ in.
Horizontal thickness of piston over piston head	4¾ in.
Kind of piston packing	Cast iron rings sprung into solid head
Diameter of piston rod	3 in.
Size of steam ports	1¼ x 16 in.
" " exhaust ports	2½ x 16 in.
Greatest lap of slide valves	5½ in.
Outside lap of slide valves	¾ in.
Inside " " " "	0 in.
Lead of slide valve in full stroke	1/8 in.
Sectional area of opening in each steam pipe connected with cylinder	15.9 sq. in.
Diameter of truck wheels	33 in.
Size of driving axle journals, diam. and length	7 x 8 in.
" " truck axle journals	5 x 8 in.
" " main crank pin journals	5½ x 4½ in.
" " coupling rod journals	Main, 6 x 3½ in.; front and back, 4½ x 3 in.
Length of driving springs, center to center of hanger	38 in.
Material of barrel of boiler	Steel
Thickness of plates in barrel of boiler	⅝ in.
Kind of horizontal seams	Butt jointed with double covering strips
Kind of circumferential seams	Double riveted
Material of tubes	Charcoal iron No. 12 W. G.
Number of tubes	254
Diameter of tubes outside	1¾ in.
Distance between center of tubes	2.425 in.
Length of tubes over tube plates	10 ft. 11¾ in.
Length of firebox inside	72 in.
Width of firebox inside	33¼ in.
Depth of firebox from under side of crown plate to bottom of mud ring	75½ in.
Water spaces, sides, back and front of firebox	2⅝ in. sides; 3 in. back; 4 in. front
Material of outside shell of firebox	Steel
Thickness of plates of outside shell of firebox	⅝ in.
" " " in sides, back and crown of firebox	½ in.
Material of smokebox tube sheet	Steel
Thickness of front and back tube plates	Front, ¾ in.; back, ½ and ¾ in.
Diameter and height of dome	27½ in. dia. x 26 in.
Kind of grate	Cast iron, plain bars
Width of bars	¾ in.
" " opening between bars	½ and ⅜ in.
Kind of blast nozzle	Single
Diameter of blast nozzles	3¾ in.
Smallest inside diameter of smokestack	15¾ in.
Height from top of rails to top of smokestack	13 ft. 1¼ in.
Smokebox	Not extended

Tender.

Diameter of tender wheels	36 in.
Size of journals of tender axles, diameter and length	4½ x 8 in.
Total wheel base of tender	14 ft. 4 in.
Distance from center to center of truck wheels of tender	4 ft. 8 in.



Baldwin Mogul Locomotive for the Great Northern Railway, England.

The Ratchford Signal Wire Compensator.

The Ratchford Wire Compensator Co., of Indianapolis, has in use on the Big Four, the Panhandle and other roads in Indiana about 40 wire compensators, which are reported as giving good service. The construction of this device is shown in the accompanying drawing. The cut, Fig. 1, shows a part of a vertical frame fixed beneath the interlocking machine in a signal cabin. The rod L is the

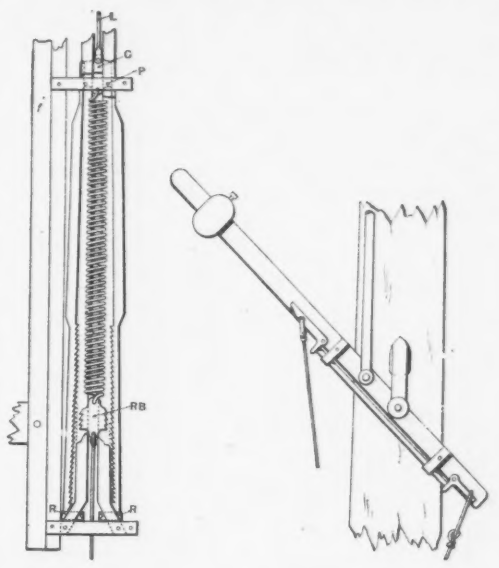


Fig. 1.

Fig. 2.

The Ratchford Compensator and Automatic Disconnector.

connection to the lever and the wire at the lower end is the connection to the signal. The frame, made of wrought iron bars, is so constructed as to be a guide for the working parts as they move up or down. The rack bars shown in the drawing, with saw teeth, are fastened to the guide block G at the upper end, while at the lower end they are free to open or close according as they may be pressed or not pressed together by the guideways. Between the rack bars is the rack block R B. When the lever is pulled the rack bars are closed together and as they engage the teeth in the rack block a rigid connection is made between the lever and the signal wire. It will noticed by the angular shape of the guides at the lower end that the rack bars are wide open at the extreme lower limit of their stroke and are fully closed when they have been lifted a short distance. When the rack bars are spread the rack block is supported by the spiral spring, which contracts if the wire is slack and expands when the wire becomes shorter.

The drawing shows the compensator for the front wire of a signal. Where there is a back wire there is a similar compensator on the other side of the frame. At the extreme end of each stroke of the lever the wire out of service keeps the spring in tension, thus readjusting the wire for each motion of the signal.

This compensator occupies a space only 3½ ins. wide, so that with levers 5 ins. apart there is ample room to put in compensators for each lever.

Fig. 2 shows the Ratchford Company's automatic disconnector for attaching wires to the balance lever on a signal post. The company furnishes the parts ready to be fixed to any ordinary counterweight lever.

Standard Specifications for Materials.

[WITH AN INSET.]

We continue the publication of abstracts of the standard specifications proposed by the American Section of the International Association for Testing Materials. We have attempted to retain the most essential parts, but to save space have cut out some paragraphs and phrases, which, while not of the first importance, are yet necessary for completeness. Even so, that which we are publishing now, and shall publish in the future, must occupy a good deal of space. Those who wish to get the specifications as issued by the committee, may do so by addressing Prof. J. M. Porter, Lafayette College, Easton, Pa., or Mr. W. R. Webster, Chairman of Committee No. 1, 411 Walnut St., Philadelphia, Pa.

Last week we published the specifications for structural steel for buildings, bridges and ships and the specifications for wrought iron. These were discussed by the American Society of Civil Engineers on Wednesday evening of this week, and also by the American Society of Mechanical Engineers at the Cincinnati meeting. The three proposed specifications which follow were also discussed by the Mechanical Engineers at the Cincinnati meeting this week.

Steel Forgings.

1. Steel for forgings may be made by the open-hearth, crucible or Bessemer process.

2. There will be four classes of steel forgings which shall conform to the following limits in chemical composition.

	Forgings of soft or low carbon steel.	Forgings of carbon steel not annealed.	Forgings of carbon steel, oil-tempered or annealed.	Forgings of nickel steel, oil-tempered or annealed.
	Per cent.	Per cent.	Per cent.	Per cent.
Phosphorus shall not exceed....	0.10	0.06	0.04	0.04
Sulphur shall not exceed.....	0.10	0.06	0.04	0.04
Nickel shall not exceed.....	....	....	....	3.75

3. The minimum physical qualities required of the different sized forgings of each class shall be as follows:

Tensile strength.	Yield point.	Elongation in 2 in.	Contraction of area.
Pounds per square inch.		Per cent.	
58,000	29,000	28	35
75,000	37,500	18	30
	Elastic limit.		
80,000	40,000	22	35
75,000	37,500	23	35
70,000	35,000	24	30
90,000	55,000	20	45
85,000	50,000	22	45
80,000	45,000	23	40
80,000	50,000	25	45
80,000	45,000	25	45
80,000	45,000	24	40
95,000	65,000	21	50
90,000	60,000	22	50
85,000	55,000	24	45

Soft Steel or Low Carbon Steel.

For solid or hollow forgings, no diameter or thickness of section to exceed 10 in.

Carbon Steel Not Annealed.

For solid or hollow forgings, no diameter or thickness of section to exceed 10 in.

Carbon Steel Annealed.

For solid or hollow forgings, no diameter or thickness of section to exceed 10 in.

For solid forgings, no diameter to exceed 20 in. or thickness of section 15 in.

For solid forgings, over 20 in. diameter.

Carbon Steel, Oil Tempered.

For solid or hollow forgings, no diameter or thickness of section to exceed 3 in.

For solid forgings of **rectangular** sections not exceeding 6 in. in thickness or hollow forgings, the walls of which do not exceed 6 in. in thickness.

For solid forgings of **rectangular** sections not exceeding 10 in. in thickness or hollow forgings, the walls of which do not exceed 10 in. in thickness.

Nickel Steel Annealed.

For solid or hollow forgings, no diameter or thickness of section to exceed 10 in.

For solid forgings, no diameter to exceed 20 in. or thickness of section 15 in.

For solid forgings, over 20 in. diameter.

Nickel Steel, Oil Tempered.

For solid or hollow forgings, no diameter or thickness of section to exceed 3 in.

For solid forgings of rectagular sections not exceeding 6 in. in thickness or hollow forgings, the walls of which do not exceed 6 in. in thickness.

For solid forgings of **rectangular** sections not exceeding 10 in. in thickness or hollow forgings, the walls of which do not exceed 10 in. in thickness.

4. A specimen 1 in. x ½ in. shall bend cold 180 deg., as follows:

Around a diameter of ½ in. for forgings of soft steel.

Around a diameter of 1½ in. for forgings of carbon steel not annealed, if 20 in. in diameter or over.

Around a diameter of 1 in. for forgings of carbon steel annealed, if under 20 in. diameter.

Around a diameter of 1 in. for forgings of carbon steel oil tempered.

Around a diameter of ½ in. for forgings of nickel steel annealed.

Around a diameter of 1 in. for forgings of nickel steel oil tempered.

5. The standard turned test specimen, ½ in. diameter and 2 in. gaged length, shall be used to determine the physical properties specified in paragraph No. 3.

6. The test specimens shall be cut cold from the

SYNOPSIS OF SPECIFICATIONS FOR CAST STEEL.

COMPILED FOR COMMITTEE No. 1.—AMERICAN SECTION, INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

Name and Date.	Chemical Properties. Carbon. Min.	Carbon. Max.	Phos. Max.	Mang. Max.	Sulp. Max.	Tension Test. Tensile strength lbs per sq. in.	Elastic limit lbs. per sq. in.	Elongation, per cent.	Reduction of Area.	Bending Test.	Percussive Test.	Number of Tests.	Location of Tests.
Baldwin Locomotive Works, 1900.	.....	.35	.06	.75	.06	60,000	.....	15 in 2 in.	.. ....	.. ..	.....	Two from each heat.	
Boston & Maine R.R. Co.....	.....	.. ....	.05	.....	.....	55,000 / 65,000	½ ult.	15 in 8 in.					
* C. B. & Q. RR., April 13, 1896	.....	.....	.06	.....	.05	60,000	.....	15 in 4 in.	.....	....	.....	Two from each heat.	
Buffalo, Rochester & Pgh. Ry., 1898	.....	.....	.05	.80	.05	65,000 / 80,000	½ ult.	15 in 8 in.					
C., M. & St. P. Ry. Co.....	.....	.....	... .	.....	.....	55,000 / 70,000							
Chicago & Northwestern Ry., 1899..	.....	.....	.....	.....	.....	60,000	30,000	15 in 8 in.					
C. N. O. & T. P. Ry	.25	.40	.05	.80	.05	65,000 / 75,000	½ ult.	15 & 17 in 2 in.					
Theo. Cooper, 1896.....	.....	.....	.....	...	.... ..	67 000	½ ult.	10 in 2 in.					
Dominion Government, 1899.....	.....	.....	.....	.....	.....	65,000 / 75,000	26,000	15 in 2 in.					
Grand Trunk Ry., 1897.....	.....	.....	.....	.....	.....	67,000	31,000	20 in 2 in.					
Great Northern Ry., March 1, 1898..	.25	.40	.....	.....	.....	64,000	.35,000	15 in 2 in.					
King Bridge Co., 1895	.....	.....	.....	.....	.....	50,000 / 60,000	....	15					
Lehigh Valley RR., July 7, 1896....	.....	.....	.....	.....	.....	60,000 / 70,000	.....	15 in 2 in. / 20 in 2 in.	.....	....	.....	Two from each heat.	
M., K. & T. Ry. Co.....	.....	.....	.08	.....	... .	70,000	35,000	15					
Mexican Central Ry., 1898.....	.....	.....	.....	.....	.....	60,000	... .	18 in 2 in.					
Mo. Pacific Ry. Co.....	.....	.....	.....	.....	... .	70,000	40.000	15 in 8 in					
N. Y. C. & H. R. RR., 1899.....	.....	(Acid O. H.)			.....	55,000 / 65,000	.....	20 in 2 in.					
N. Y. C. & H. R. RR., 1899.....	.40	(.08—Acid—O.H.)			.....	72,000 / 80,000	½ ult.	15 in 2 in.	25%				
N. Y., Ch. & St. L. R. R. Co.....	.....	.....	.07	.....	.....	65,000 / 70,000	35,000	15 in 2 in.					
N. Y., N. & H. R.R. Co....	.....	.....	.07	.....	.. ....	65,000 / 70,000	35,000	15 in 8 in.					
Norfolk & Western RR., Sept 5, 1893	.....	.....	.....	.....	.....	60.000 / 70,000	.....	15 in 2 in. / 20 in 2 in.	.....	....	.....	Two from each heat.	
Northern Pacific Ry., Dec. 1, 1898 ..	.....	.....	.....	.....	.....	55,000 / 70,000							
Pencoyd Iron Works, 1895	.25	.40	.08	O. H.		70,000	35,000	20					
Penna RR., Jan. 1, 1897.....	.....	.....	.....	.....	.....	67,000	36,000	20 in 2 in.					
Phoenix Bridge Co.....	...	.....	.....	.....	.....								
Southern Ry., 1897	.25	.40	.08										
Seaman H. B	.....	.....	.....	.....	.....	65,000	35,000	15 in 2 in.					
** New York Rapid Transit Tunnel	.....	.....	.....	Test to be made with a ¾ in. round cut from coupon.		70,000	35,000	15 in 2 in.	20%	....	.....	.....	Coupon—cast with the piece and cut off after casting is annealed.
** New East River Bridge at New York City, Nov.. 1899.....	.....	.....	.06	.80	.04	60,000	.....	20 in 2 in.	.....	90° D = 3 T.	....	....	From coupons on the annealed casting.
** United States Army, Apr. 10, 1899	Cast steel No. 1		.05	.....	.....	60,000	.....	18 in 2 in.	30%	.....	.....	.....	From coupons cast on the piece.
	Cast steel No. 2		.05	.....	.....	65,000	.. ..	13 in 2 in.	18%				
* United States Navy, 1890.....	Class A No. 1=		.06	.....	.....	62,000	.....	15 in 8 in. / 20 in 2 in.	20%	1 in. sq. = 120° / 1 in. x ½ in. = 150°	For large and important castings.	One or more from each casting of over 200 lbs.	From coupons on the casting or from sink-heads, when of sufficient size.
	Class A No. 2=		.06	.....	... .	70 000	.....	10 in 8 in. / 15 in 2 in.	20%	1 in. sq. = 90° / 1 in. x ½ in. = 120°			
** United States Treasury Dept Revenue Cutter Service, 1900.	For moving parts.....		.....	.....	.....	60,000	.....	24 in 2 in.	.....	1 in. x ½ in. 120° D=4 T	Number of Tests.—One tensile and one bending test from each of the larger castings and from each heat from which smaller castings are made.		From coupons attached to castings or from sink-heads.
	For other parts.....		.....	.....	.....	60,000	.....	20 in 2 in.	.....	1 in. x ½ in. 90° D=4 T			
Wabash Railroad, Mar. 1, 1898	... .	.....	.... ..	.....	.....	55,000 / 70,000	35,000	13 in 8 in.	17%				
J. A. L. Waddell, 1898.....	.25	.40	.05 (Acid O.H.)	.80	.05	65,000 / 75,000	½ ult.	15 in 2 in. fixed castings. / 17 in 2 in., movable castings					

* All castings to be annealed unless otherwise ordered. ** All castings must be annealed.

To Accompany the Proposed Specifications Recommended by Committee No. 1, American Section, International Association

Specification issued by	Date of specification now in use.	Materials specified.	Process of manufacture specified.	Chemical properties			
				Carbon.	Manganese.	Silicon.	P
United States Navy	Jan. 2, 1900.	Gun tubes.	Open-hearth.				
" "	"	" jackets.	" "				
" "	"	" hoops.	" "				
" "	"	" trunnion bands.	" "				
" "	"	" plugs.	" "				
" "	"	" mushrooms.	" "				
"	1895.	Minor caliber rapid fire gun forgings.	" "				
"	June 19, 1899	Hull material, tillers, stem and stern posts.	Not specified.				
"	"	" miscellaneous forgings.	" "				
"	"	" blooms for misc. forgings made at smithy.	" "				
"	May 19, 1899	Machinery material, high grade machinery forgings.	Open-hearth, nickel steel.				N
"	"	" " Class A, No. 1, machinery forgings.	" "				N
"	"	" " Class A, No. 2, machinery forgings.	" "				N
"	"	" " Class B, machinery forgings.	" carbon steel.				N
"	"	" " blooms and billets for forgings.	" nickel steel.				N
"	"	" " blooms and billets for forgings.	" carbon steel.				N
		" " forgings not essential to the structural strength of the engines and boilers.	Open-hearth or Bessemer soft steel. / Open-hearth or Bessemer medium steel.				
"	Dec. 1, 1897.	Whitehead torpedo air flasks.	Open-hearth.				
United States Army	Sept. 17, 1896.	Tubes, field cannon of all calibers.	"				
"	"	" siege cannon of all calibers.	"				
"	"	" seacoast cannon, 8-in. caliber and over.	"				
"	"	" " " " "	Open-hearth, nickel steel.				
"	"	Jackets, field cannon of all calibers.	Open-hearth.				
"	"	" siege cannon of all calibers.	"				
"	"	" seacoast cannon, 8-in. caliber.					
"	"	" " " 8-in. caliber and over.	Open-hearth, nickel steel.				
"	"	" " " 10-in. " "	Open-hearth.				
"	"	Hoops, cylindrical, rough-finished size in forging:—					
"	"	" not more than 11 in. inside diam., nor over 120 in. long.	Open hearth.				
"	"	" more than 11 in. inside diam.; not more than 24 in. inside diam.; not over 150 in. long.	" "				
"	"	" more than 24 in. inside diam.	" "				
"	"	Trunnion hoops, field cannon of all calibers.	" "				
"	"	" siege cannon of all calibers.	" "				
"	"	" seacoast cannon of 8 in. caliber and over.	" "				
"	"	Breech blocks, hinge pins, spindles and rollers, ditto.	Field and siege cannon of all cals. / seacoast cannon of 8-in. cal. and over.	" "			
"	"	Lever handles, breech plates, face plates and block carriers, ditto.	field and siege cannon of all cals. / Seacoast cannon 8-in. cal. and over.	" "			
"		Gas check cups and rings, bars for securing pins, ditto.	field and siege cannon, all cals. / seacoast cannon, 8 in. cal. and over.	" "			
"	April 10, '99.	Gun carriage parts, forged steel No. 1.	Not specified.				
"	"	" " " " " 2.	" "				
"	"	" " " " " 3.	" "				
United States Navy	May 18, 1898.	Armor plate bolts.	Open-hearth.				
"	"	" nuts.	" "				
U. S. Treasury—Engineer-in-Chief Revenue Cutter Service	1900.	Engines and machinery. / Revenue Cutters, Nos. 7 & 8. / ditto.	Shafting, steel columns, reverse shaft and crosshead slippers. / Piston, connecting and eccentric rods valve stems, crossheads, and main links.				Also all other miscellaneous forgings not shown / Also connecting rod bolts, main bearing bolts, and link and valve stem bolts.
Wm. Cramp & Sons Ship & Eng. Bldg. Co	1899	Steel shafting for engines Nos. 198-201; 2 new boats for Int. Nav. Co	" "				
ditto.	"	Pins for built up shafts, ditto.	" "				
ditto.	"	Crank webs, ditto.	" "				
ditto.	"	Cross heads, connecting and piston rods, ditto.	" "				
ditto.	Aug. 17, 1898.	Engines for Russian cruiser and battleship. / ditto. / Connecting rods and piston rods. / Crossheads.	" "			†	N
ditto.	"	ditto.	" "				N
ditto.	"	ditto. Shafting.	" "				N
ditto.	"	ditto. / Reverse shafts and engine columns.	" "				N
ditto.	"	ditto. / Tie rods, miscellaneous forgings and blooms.	" "				N
American Bureau of Shipping	1899.	Crank, line or propeller shafts.	" "				
Bethlehem Steel Co		Standard shafting and machinery steel.	" "				
ditto.		Standard nickel steel shafting.	Open-hearth nickel steel.				N
E. D Leavitt	1896.	Steel forgings.	"				
ditto.	"	ditto.	"				
ditto.	"	ditto.	Open-hearth.				
Sprague Electric Co	"	Elevator bars.	"				
American Pulley Co	Aug. 9, 1899.	Forgings for 42 in. rim forming press.	Low phosphorus open-hearth.	Desired .30.			N
Winchester Repeating Arms Co	Dec. 3, 1896	Gun barrels.	Open-hearth, nickel steel.				
Lehigh Valley Railroad	Sep. 16, 1895.	Miscellaneous steel forgings.	Open-hearth.				N
Pensylvania Railroad	Aug. 15, 1893	Billets for main and parallel rods.					
ditto.	Nov. 8, 1897.	Crank pin steel.		‡Desire .45.	Desire not over .60.	Desire not over .05.	Desi Reje
Philadelphia & Reading Railway	May 23, 1899	Steel crank pin forgings.					
ditto.	"	Steel piston rods.					
Erie Railroad	Feb. 1, 1899.	Miscellaneous forgings.	Open-hearth.				N
L. S. & M. S. Ry		Piston rods.	" "				N
N. Y. C. & H. R. RR	Oct., 1899.	Steel forgings.	" "	Not over .40 / Not under .27	Not over .60		N
B & O. RR	Sept. 1, 1898.	Crank pins.	" "	Not under .40			N
ditto.	Aug. 1, 1896.	Main and parallel rods.	" "		Not over .60	§	N
Baldwin Locomotive Wks.	June 1, 1897.	Blooms for use in axles, pins, rods and other forgings.	" "	Desired .40	Not over .60	‖	N
Chicago & Northwestern RR	April 1, 1898.	Steel blooms for locomotive parallel rods.	" "				
Missouri, Kansas & Texas RR	Feb. 2, 1900.	Steel blooms for forgings.	" "				N
Southern Railway Co	Feb. 1, 1896.	Main, parallel and piston rods.					
ditto.	May 9, 1896.	Crank pins.					N
Chicago Burlington & Quincy RR	Feb. 20, 1897.	Side rods and piston rods.	Open-hearth.	Not over .40 / under .25	Not over .65		N
ditto.	"	Crank pins.	" "	Not over .45 / under .30	Not over .65		N
Norfolk & Western RR.	Jan. 1, 1891.	Crank pins.					
ditto.	April 25, 1891	Billets for rods and guides.					N

* Quench test, 180° D = 2 T. † 3.25 per cent. of Nickel. ‡ 1

SYNOPSIS OF SPECIFICATIONS FOR STEEL FORGINGS.

COMPILED FOR COMMITTEE NO. 1.—AMERICAN SECTION, INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

ies.		Minimum Physical properties required.					Bending test.				
hosphorus.	Sulphur.	Pounds per sq. in.		Per cent.		Size of specimen.	Cold test.	Size of specimen.	Treatment specified.	Finish.	
		Tensile strength.	Elastic limit.	Elongation.	Contraction of area.						
.....	.....	78,000	40,000	20	35	2 in. x .5 in.	.....	.....	Annealed, oil-tempered and annealed.	As per drawing. To be free from slag, seams, cracks, cavities, flaws, blow holes, unsoundness, foreign substances and all other defects affecting their resistance and value.	Inspec the v facti
.....	.....	85,000	43,000	18	30	"	.....	.....	"	"	
.....	.....	95,000	50,000	18	30	"	.....	.....	"	"	
.....	.....	95,000	50,000	18	30	"	.....	.....	"	ditto.	
.....	.....	78,000	40 000	18	30	"	.....	.....	"	ditto.	
.....	.....	78,000	40 000	20	35	"	.....	.....	"	ditto.	
.....	.....	87,000	45,000	T = 17, L = 20	.....	"	.....	.....		ditto.	
.....	.....	60,000	.....	30	.....	"	Flat.	½ diam.	None specified.	To drawing, free from all defects.	
.....	.....	60,000	.....	30	.....	"	"	"	" "	ditto.	
.....	.....	58,000	.....	28	.....	"	"	"	" "	ditto.	
ot over .06	Not over .04	95,000	65,000	21	.....	"	180° D = 2T	1 in. x ½ in.	Oil-tempered & annealed	To be free from slag, cracks, blowholes, hard spots, sand, foreign substances, and all other defects affecting their value. To drawing.	
ot over .06	Not over .04	80,000	50,000	25	.....	"	180° D = 2T	"	" optional.	ditto.	
ot over .06	Not over .04	80,000	45,000	26	.....	"	180° D = T	"	Annealed.	ditto.	
ot over .06	Not over .04	60,000	30,000	30	.....	"	180° D = T	"	"	ditto.	
ot over .06	Not over .04	80 000	50,000	24	.....	"	180° D = 2T	"	May be annealed.	ditto.	
ot over .05	Not over .04	60,000	30,000	26	.....	"	180° D = T	"	"	ditto.	
.....	.....	52,000 to 62,000	26,000 to 31,000	25	.....	8 in. x 1.5 in.	Flat.	.....	None specified.	ditto.	
.....	.....	60,000 to 70,000	30,000 to 35, 00	22	.....		180° D = T	.....	"	ditto.	
.....	.....	.....	68,000	14	.....	2 in. x .5 in.	.....	.....	Oil-tempered and annealed.	To drawing. To be free from slag, seams, cracks, cavities, flaws, blowholes, unsoundness, foreign substances and all other defects affecting their resistance and value.	
.....	.....	78,000	42,000	20	35	2 in. x .505 in.	.....	.....	Annealed, oil-tempered and annealed.	To drawing and free from seams, cracks and slag, folds or other defects.	
.....	.....	78 000	42 000	18	30	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	.....	78,000	42 000	17	30	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	85,000	53,000	18	35	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	86,000	46,000	17	30	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	.....	86,000	46,000	16	27	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	85,000	46,000	16	27	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	80 000	55,000	17	32.50	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	83,000	44,000	16	27	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	90 000	50 000	18	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	.....	93,000	53,000	15	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	93,000	53,000	13	.....	4 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	90 000	50,000	18	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	.....	90,000	50,000	15	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	90,000	50,000	13	.....	4 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	85,000	45,000	18	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	.....	85,000	45.000	16	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	75,000	40,000	20	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	.....	75,000	40,000	18	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	125,000	75,000	12	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	.....	125,000	75,000	10	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	.....	60,000	.....	28	.....	2 in. x .505 in.	.....	.....	Annealed, at a temperature of at least 1100° F.	To be sound, of uniform quality and condition, and free from seams, cracks or other defects.	
.....	.....	68,000	.....	22	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	.....	90,000	.....	16	27	2 in. x .505 in.	.....	.....	Oil-tempered and annealed.	Free from imperfections of manufacture, and from such cracks, cavities, flaws, slag, sand spots, cinders, etc., as would diminish their resistance or value.	
.....	.....	70,000	.....	25	.....	2 in. x .5 in.	.....	.....			
.....	.....	78,000	.....	15	.....	2 in. x .5 in.	.....	.....			
on line next below.		60,000	.....	See remarks.	30	2 in. x .798 in.	Flat.	1 in. x ½ in.	Annealed.	All steel forgings to be without welds and free from defects.	Every fa for tes course Subject t and fu
eccentric rod bolts and studs		80,000	.....	26	.....	2 in. x .798 in.	180° D = 2T	½ in. diam.	"	Sound, free from defects.	
.....	.....	60,000	.....	In 2 in. 26.	.....	.....	180° D = 3T	½ in. diam.	.....	.....	
.....	.....	65,000	.....	In 2 in. 25.	.....	.....	"	"	.....	"	
.....	.....	60,000	.....	In 2 in. 26.	.....	.....	"	"	.....	"	
.....	.....	65,000	35,000	In 2 in. 25.	.....	.....	"	Longitudinal.	.....	"	
ot over .06	Not over .04	80,000	45,000	In 2 in. 28.	See remarks.	.....	180° D = 5/8 in.	1 in. square longitudinal.	Oil-tempered and annealed.	Free from slag, cracks, blowholes, hard spots, sand, foreign substances and all other defects.	Rus-ia all pa
ot over .06	Not over .04	65,000	.....	In 2 in. 25.	.....	.....	"	"	.....	ditto.	
ot over .06	Not over .04	Upper end 62,720. Lower end 62,720	35,000 35,000	In 2 in. 26 In 2 in. 24	.....	.....	"	"	.....	ditto.	
ot over .06	Not over .04	62,720	.....	In 2 in. 25.	.....	.....	"	"	.....	ditto.	
ot over .06	Not over .04	62,720	.....	In 2 in. 24	.....	.....	.....	.....	.....	ditto.	
.....	.....	58,000 Not over 68,000	.....	20 25	.....	8 in. long. 4 in. long.	.....	.....	.....	.....	To be ca
ot over .04	Not over .04	70,000	55,000	25	.....	2 in. x .5 in.	.....	.....			
.....	.....	80,000	45,000	25	.....	"	.....	.....			
.....	.....	.....	50,000	18	.....	10 in.	.....	.....	Oil-tempered.		
.....	.....	.....	45,000	18	.....	10 in.	.....	.....	Annealed.		
.....	.....	.....	45,000	18	.....	10 in.	.....	.....	Oil-tempered.		
.....	.....	.....	80,000	.....	.....	.....	.....	.....	.....		
t over .05	.....	70,000	.....	In 8 in. 25	.....	.....	.....	.....	.....	Free from flaws and seams and of best grade of forgings for machine construction.	Inspector is bei
.....	.....	.....	80,000	20	.....	2 in. x 5 in.	.....	.....			
t over .06	Not over .06	80,000	.....	17	.....	2 in. x .625 in.	.....	.....	Annealed	Sound throughout, free from piping and surface imperfections.	Inspector of this s
.....	.....	80,000	.....	12	.....	2 in. x .625 in.	.....	.....	.....	.....	
e not over .03. t if over .05.	Desire not over .01.	80,000 Not over 90,000	.....	12	.....	8 in. long.	.....	.....	.....	.....	
.....	.....	80,000	.....	In 2 in. 15.	.....	5 in. sq. x 3 in. bet. shoulders.	.....	.....	.....	Free from physical defects before and after working.	Fractur coarse
.....	.....	70,000	.....	In 2 in. 25.	.....	5 in. sq. x 3 in. bet. shoulders.	.....	.....	.....	ditto.	
ot over .05	Not over .05	80,000 Not over 90,000	.....	In 2 in. 17.	.....	2 in. x .875 in.	.....	.....	.....	.....	
ot over .05	Not over .05	60,000 Not over 70,000	.....	In 8 in. 22.	.....	.....	.....	.....	.....	.....	
ot over .04	Not over .04	75,000 Not over 85,000	.....	In 2 in. 20.	.....	.....	.....	.....	.....	Ingots for forgings to be free from pipes, segregation and like imperfections.	
ot over .06	Not over .04	85,000	.....	In 2 in. 15. See remarks.	.....	2.5 in. x .5 in.	.....	.....	.....	.....	Will be destin
ot over .05	Not over .04	70,000	.....	In 2 in. 20	.....	2.5 in. x .5 in.	.....	.....	.....	.....	
ot over .05	Not over .05	75,000 Not over 90,000	.....	In 2 in. 15	.....	2 in. x .875 in.	.....	.....	.....	Free from seams, slivers and other surface defects.	
.....	.....	75,000	.....	In 8 in. 18	.....	8.5 in. x .625 in	.....	.....	.....	To be free from cracks, flaws, and defects of all kinds.	Manufa assista Small l
ot over .05	.....	60,000	.....	In 2 in. 15.	.....	.....	.....	.....	.....	.....	
.....	.....	70,000 Not over 80,000	...	In 2 in. 20.	.....	2.5 in. x .5 in.	.....	.....	.....	To be free from cracks, flaws and seams.	Manufa assista
ot over .05	.....	85,000	.....	In 2 in. 15.	.....	2.5 in. x .5 in.	.....	.....	.....	ditto.	
ot over .05	Not over .05	70,000 Not over 80,000	.....	In 4 in. 22	.....	4.5 in. x .625 in.	.....	.....	.....	.....	
ot over .05	Not over .05	75,000 Not over 85,000	.....	In 4 in. 20	.....	4.5 in. x .625 in.	.....	.....	.....	.....	
.....	.....	80,000	.....	12	.....	2 in x .625 in.	.....	.....	.....	.....	
ot over .05	.....	80,000	.....	15	.....	2 in. x. .625 in.	.....	.....	.....	.....	

rillings will be taken with 5/8 in. drill 40% of distance out from centre of pin, from either end of a pin, selected at random from each lot of 50, drilling to be parallel to the axis of the pin. § Check analysis from test piece.

	Inspection.	Number and location of tensile tests specified.	Percentage of top & bottom discard from all ingots specf'd.	A certain reduction in forging specified.	Remarks.
cks, sub-sist-	Inspector to have free access to all parts of the works where material is being manufactured.	Transverse. Yes.	Yes.	Yes.	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	Transverse and longitudinal. Yes.	"	"	
	ditto.	Transverse, also longitudinal for elongation. Yes.	"	No.	
	ditto.	Longitudinal. Yes.	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
and, ting	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" No.	No.	"	
	ditto.	" "	"	"	
ties. d all	ditto.	Transverse. Yes.	Yes.	Yes.	
olds	ditto.	Tangential. "	"	"	Specification calls for powder and hydraulic tests.
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	No.	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	" "	"	"	
	ditto.	Tangential where possible, otherwise longitudinal.	"	"	
	ditto.	ditto.	"	"	
	ditto.	ditto.	"	"	
	ditto.	ditto.	"	"	
	ditto.	ditto.	"	"	
	ditto.	ditto.	"	"	
	ditto.	ditto.	"	"	
free	ditto.	ditto.	No.	"	
	ditto.	Longitudinal. Yes.	"	"	
	ditto.	" "	"	"	
uch te ,	ditto.	" "	"	"	
	ditto.	" "	"	"	
rom	Every facility shall be extended to the inspector for testing and examining the material in course of manufacture at the mill.	" "	Yes, top. "	"	For specimens taken between crank webs, 28.00 per cent. elongation.
	Subject to inspection at any stage of progress and further tests may be demanded.	Tensile specimens from each end of each forging.	No.	No.	
	ditto.	ditto.	"	"	
	ditto.	Transverse specimens from each end of each web.	"	"	
	ditto.	Longitudinal from each head of connecting rods and each end of piston rods.	"	"	
for	Russian Navy Inspector to have free access to all parts of the works during progress of manufacture.	Longitudinal from each end.	Yes	No.	Elongation to average 25 per cent.
		ditto.	"	"	
	ditto.	Piece to be cut from each end of each forging for longitudinal tests. Four test pieces to be taken from the end which was nearest the top of the ingot, two of which shall be taken from the outside and two midway between center and radius. Two test pieces to be taken from the lower end of the forging midway between center and radius.	"	"	
	ditto.	.....	"	"	
	ditto.	.....	"	"	
	To be carefully examined after being turned.	To be cut cold.	.....	.....	
org-	Inspector to have access to the shops where work is being done for purposes of inspection.	Small forged test bars of same heat.	No.	No.	
per-	Inspector at steel works to see that conditions of this specification are complied with.	Longitudinal. To be machined cold and taken half-way between central axis and outside from full-sized prolongation. Test piece to be cut from upper end of upper bloom in ingot.	Yes. top.	No	
....	.....	One billet from each lot of 25 or less, to have piece drawn from it under the hammer and turned to size for tests.	No.	"	
....	.....	Two from any part of one pin selected at random from each lot of 50, centre line of test pieces not to be nearer than 1 in. to centre line of pin.	"	"	if two tensile tests of one order differ over 5,000 pounds or over 5 per cent. in elongation, the order is rejected.
g.	Fractured ends of test pieces to be free from coarse granular appearance.	Longitudinal to be taken not less than 1½ in. from centre of a pin to be selected at random from each lot of 50 or less.	"	"	
	ditto.	Longitudinal taken midway between central axis and outside of one rod selected at random from each lot of 25 or less.	"	"	
....	.....	Each test specimen to be machined cold, longitudinally taken from a prolonged portion of forging, midway between center axis and surface.	Yes, top.	No.	
....	.....	.....	No.	"	
on	.....	.....	"	"	
....	Will be inspected and tested on its arrival at destination.	Two tests cut from pin of each heat, cut midway between center and edge.	"	"	As many pins as possible to be made from a heat. Elongation may be 12 50% if T.S. is above 90,000 pounds.
....	.....	Two tests cut from one rod from each heat, cut midway between center and edge.	"	"	As many rods as possible to be made from a heat.
.	.....	Test piece to be machined cold from full-sized bloom of each heat.	"	"	No chipping permitted for the removal of defects except as authorized by inspector.
ds.	Manufacturer to furnish test apparatus and assistance when inspection is at mfrs. works. Small lots inspected at destination.	One end of each bloom must be drawn to a test piece 2 inches square by 18 inches long, to remain attached until bloom is inspected; a tensile test specimen is to be cut from this bar, midway between centre and outside.	No.	No.	
..	.....	Test piece cut from forging four inches in diameter, hammered from bloom and allowed to cool.	"	"	
	Manufacturer to furnish test apparatus and assistance to inspector free.	One rod from each heat must be 6 inches extra long, and from this two test pieces will be cut.	"	"	Rods to be made from as few heats as possible.
	ditto.	One pin from each heat will have two test pieces cut from it.	"	"	As many pins as possible from each heat.
....	.....	One end of each billet to be drawn down to a test bar 2 inches square and 10 inches long, to remain on the billet; a tensile test specimen will be cut from the bar, midway between centre and outside.	"	"	
....	.....	ditto.	"	"	
....	.....	One ingot selected at random from each lot of 51 shall have two test specimens cut from any part of it, provided centre line of test pieces falls one and one-half inches from center line of ingot.	"	"	
....	.....	One billet from each shipment will have a piece drawn from it under the hammer about two inches square by 12 inches long, from which tensile test specimen will be turned down.	"	"	

n test piece. ‖ To be analyzed by Baldwin Loco. Works. Drillings taken midway between center and surface.

SYNOPSIS OF SPECIFICATIONS FOR BOILER AND FIREBOX STEEL.

COMPILED FOR COMMITTEE NO. 1—AMERICAN SECTION, INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

Name and date.	Grade.	Chemistry. Car. Min.	Car. Max.	Phos. Max.	Mn. Max.	Sil Max.	Sul. Max.	Copper Max.	Physical Requirements. Elastic Limit lbs. per sq. in.	Tensile strength lbs. per sq. in. Min.	Tensile strength lbs. per sq. in. Max.	Elongation, per cent. in 8 in.	Reduction of area, per cent.	Bends: H = Hot. C = Cold. Q = Quench.	Homogeneity test.	Number of tensile tests.	Remarks.
Association, American Steel Mfgrs., 1896	flange or boiler			.06			.04		½	52,000	62,000	25		180° flat C., Q.		Two per melt.	
	firebox.			.04			.04		½	52,000	62,000	26		" " "		"	
Baltimore and Ohio R. R., No. 14a, Dec. 1, 1897	boiler			.05			.04			55,000	65,000	25		" " H., C., Q.	Yes.	One per slab.	Either long'l or trans.
	firebox.			.035	.45	.03	.035	.05		53,000	63 000	26		" " "	Yes.	Two per slab.	One long'l, one trans.
Brooks Locomotive Works	boiler shell									52,000	60,000	25	50	" " C., Q.		One per plate.	
	firebox.	.15	.25	.03	.45	.035	.03			50,000	58,000	26	56	" " "		"	
Burnham, Williams & Co., Jan. 1, 1895	flange	.15	.25	.05	.45	.03	.05			55,00	65,000	20				One per slab.	
	firebox.	.15	.25	.03	.45	.13	.035										
Canadian Pacific Ry.	boiler									50,000	65,000	25 in 2 in.				"	
	firebox.			.025	.40	.025	.025			50,000	58,000	28 in 8 in. ⅜ in. t. over		180° flat, C., Q.		"	
												25 in 8 in. under ⅜ in.				"	
C. C. C. & St. L. Ry., No. 7, May, 1894	boiler									55,000	65,000	20		" " "		"	
	firebox.	.15	.25	.035	.45	.03	.035			55,000	65,000	22		" " Q.	Yes.	"	
Chicago, Burlington & Quincy, No. 1, Sept., 1895.	boiler shell	.15	.25	.035	.45	.03	.035			55,000	65,000	20 in 1¼ in. plt.		" " H., C., Q.	Yes.		
	fire box.	.15	.25	.03	.45	.03	.035					22					
Cooke Locomotive Works	boiler and flange firebox	Same as Association American Steel Mfgs.															
Great Northern Ry., No. 16, Oct. 1, 1895										55,000	65,000	23 long'l.		180° flat C., Q.		Two per slab.	One long'l, one trans. Plates will not be rejected for high T. S. if elongation is 28% log'l and 25% trans. Plates will not be rejected for high T. S. if elongation is 30% long. and 28% trans.
		.13	.20	.03	.40	.02	.03	.03		52,000	60,000	20 trans.		" " "	Yes.		
												25 l. or t.		" " H., C., Q.		One each plate	
Hartford Steam Boiler Inspection & Insurance Co.										55,000	60,000	25	56				
Heine Safety Boiler Co.				.04			.03		32,000	55,000	62,000	25 in ⅜ in. t. over.					
												22.5 over ⅛ in. in to ⅜ in,		180° flat H., C. up to ½ in. t.	Yes.	Three per heat	
												20 in ⅛ in. or less.		180° D. = 1½ t. H., C. o. ½ in. t.			
L. S. & M. S., Sept. 16 1897	boiler firebox.									54,000	62,000	25 to 32.		180° flat, H., C.		One each plate	
Missouri Pacific Ry., No. 10, Sept. 22, 1897	boiler	.12	.20	.05	.30/.40	.02	.03			48,000	55,000	24	50	180° flat, Q.	Yes.	four per slab.	
	firebox.	.12	.20	.03	.30/.40	.02	.02			48,000	55,000	25	55	" " "	Yes.	"	
Norfolk and Western Ry., No. 4C., Jan. 1, 1895	shell									55,000	65,000	20		" " C., Q.		One per slab	
	firebox.	.15	.25	.035	.45	.03	.035			55,000	65,000	22 in 1/16 in. t. over.		" " H., C., Q.	Yes.	"	
												20 in ¼ in. t.		" " "			
Northern Pacific Ry., No. 13, Nov. 1, 1898	boiler shell			.035	.45		.03			57,000	65,000	24			Yes.	One per plate.	
	firebox.	.12	.25	.035	.40	.03	.02			55.000	65,000	26				"	
Penna. Railroad Co., No. 1B., Oct. 26, 1896	boiler shell			.05						55,000	65,000	1,400,000 ÷ ult.				"	Plates will not be rejected for high T. S. if elong. is 28% or over.
	firebox.	.15	.25	.035	.45	.03	.045	.05		55.000	65,000	1,450,000 ÷ ult.			Yes.	"	" " " " " " 30% "
Pgh., Bessemer and Lake Erie.	boiler	.15	.25	.05	.45	.05	.05			52.000	62,000	25				One per slab.	
	firebox.	.15	.25	.03	.45	.13	.035										
Pgh. Locomotive Works. Jan. 2, 1894	flange & shell		.22	.05	.35/.50	.045	.015			52,000	62,000	25 in ⅜ in. t. over.		180° flat, C., Q.		"	Fire box plates ¼ in. t. will be accepted with T. S. 60,000 lbs. El, 22%.
	firebox.	.12	.20	.035	.35/.50	.04	.035			50,000	58,000	22.5 in 1/16 in. t.		" " "		"	
												20 in ¼ in.				"	
Queen and Crescent Route, No. 1, July 30, 1894	boiler	.15	.25	.035	.45	.03	.045			55,000	65.000	25				"	
	firebox.											22		" " C.		"	
Richmond Loco. & Mch. Works	boiler	.15	.25	.05	.45	.03	.05			55,000	65,000	20		" " H., C., Q.	Yes.	"	Plts. will not be rejected for high t. s. if elon. is 27% or over } If not caused
	firebox.	.15	.25	.035	.45	.03	.035			55,000	65,000	23 over ¼ in. thick.		" " "	Yes.	"	" " " " " " " 30% " } by cold rolling.
												22 in ¼ in. t.		" " "			
Schenectady Loco. Works, No. 1B, Aug. 12, 1895	boiler			.05						55,000	65,000	24		" " "		"	
	firebox.	.15	.25	.035	.45	.03	.035			55,000	65,000	25		" " "		"	
Southern Pacific Co., No. 27, Sept. 25, 1897	boiler shell			.035	.45		.03			50,000	62,000	26		" " C., Q.			
	firebox.																
Southern Ry. Co., Dec. 1, 1895	boiler			.05						55,000	65,000	22				"	
	firebox.	.15	.25	.035	.45	.03	.035			55,000	65,000	20 in ¼ in. t.				"	
												23 in 1/16 in. t.			Yes.	"	
												21 in ¼ in. t.					
Wabash Railroad	boiler	.12	.20	.05	.30/.40	.02	.03			54,000	62,000	24	50	180° flat, Q.	Yes.	Four per slab.	Compare with Mo. Pacific Ry.
	firebox.	.12	.20	.03	30/.40	.02	.02			54,000	62,000	25	55	" " "	Yes.	"	
White Pass & Yukon Ry., 1899	boiler.									60,000	70,000	20 in 10 in.		" " C.		One per plate.	
U. S. Marine Law, Jan., 1898	boiler.						.04		As specified on order.			25 in 2 in. up to ¼ in.	50 in ½ in. t. and under.			One per slab.	
												25 in 4 in. over ¼ in. to 1/16 in.	45 over ½ in. to ¾ in.				
												25 in 6 in. over 1/16 in. to 1¼ in.	32.5 over ¾ in. to 1¼ in.				
Mexican Central Ry., Oct. 2, 1899	boiler firebox.	Same as Penna. R. R. Co.															

To Accompany the Proposed Specifications, Recommended by Committee No. 1, American Section, International Association for Testing Materials.

forging or full-sized prolongation parallel to the axis and half way between the center and outside, the length of the specimen to correspond with the direction in which the metal is most drawn out or worked. When forgings have large ends or collars, the test specimens shall be taken from a prolongation of the same diameter or section as that of the forging back of the large end or collar. In case of hollow shafting, either forged or bored, the specimen shall be taken within the finished section prolonged, half way between the inner and outer surface of the wall of the forging.

7. The specimen for bending test, 1 in. x ½ in., shall be cut as specified in paragraph No. 6. The bending test may be made by pressure or by blows.

8. The yield point specified in paragraph No. 3 shall be determined by observation of the drop of the beam, or halt in the gage of the testing machine.

9. The elastic limit specified in paragraph No. 3 shall be determined by means of an extensometer, which is to be attached to the test specimen in such manner as to show the change in rate of extension under uniform rate of loading, and will be taken at that point where the proportionality changes.

Steel Castings.

1. Steel for castings may be made by the open-hearth, crucible or Bessemer process. Castings to be annealed or unannealed, as specified.

2. Castings in which no physical requirements are specified, shall not contain over 0.40 per cent. of carbon, nor over 0.08 per cent. of phosphorus.

3. Castings subjected to physical test shall not contain over 0.05 per cent. of phosphorus, nor over 0.05 per cent. of sulphur.

4. Tested castings shall be of three classes: "Hard," "medium" and "soft." The minimum physical qualities required in each class shall be as follows:

	Hard.. castings.	Medium castings.	Soft castings.
Tensile strength, lbs. per square inch.	85,000	70,000	60,000
Yield point, lbs. per square inch.....	38,250	31,500	27,000
Elongation, per cent. in two inches..	15	18	22
Contraction of area, per cent.....	20	25	30

5. A test to destruction may be substituted for the tensile test, in the case of small or unimportant castings, by selecting three castings from a lot. A lot shall consist of all castings from the same melt or blow, annealed in the same furnace charge.

6. Large castings are to be suspended and hammered all over.

7. A specimen 1 in. x ½ in. shall bend cold around a diameter of 1 in., through an angle of 120 deg. for "soft" castings and of 90 deg. for "medium" castings.

8. The standard term test specimen, ½ in. diameter and 2 ins. gaged length, shall be used to determine the physical properties specified in paragraph No. 4.

9. The number of standard test specimens shall depend upon the character and importance of the castings. A test piece shall be cut cold from a coupon. The coupon or sink-head must receive the same treatment as the casting before the specimen is cut out, and before the coupon or sink-head is removed from the casting.

10. One specimen for bending test, 1 in. x ½ in., shall be cut cold from the coupon or sink-head of the casting or castings as specified in paragraph No. 9. The bending test may be made by pressure or by blows.

Open-Hearth Boiler Plate and Rivet Steel.

1. Steel shall be made by the open-hearth process.

2. There shall be three classes, namely: Flange or boiler steel, firebox steel and extra soft steel, which shall conform to the following limits in chemical composition:

	Flange or boiler steel. Per cent.	Fire box steel. Per cent.	Extra soft steel. Per cent.
Phosphorus shall not exceed	0.06	0.04	0.04
Sulphur shall not exceed	0.05	0.04	0.04
Manganese	0.30 to 0.60	0.30 to 0.50	0.30 to 0.50

3. Steel for boiler rivets shall be of the extra soft class, as specified in paragraphs Nos. 2 and 4.

4. The three classes, flange or boiler steel, firebox steel and extra soft steel, shall conform to the following physical qualities:

	Flange or boiler steel.	Fire box steel.	Extra solt steel.
Tensile strength, lbs. per square inch	55,000 to 65,000	52,000 to 62,000	45,000to 55,000
Yield pint in lbs. per square inch shall not be less than..	33,000	32,000	30,000
Elongation, per per cent. in 8 inches shall not be less than	25	26	28

5. For material less than five-sixteenths inch ($\frac{5}{16}$ in.), and more than three-fourths inch (¾ in.) in thickness, the following modifications shall be made in the requirements for elongation:

(a) For each increase of one-eighth inch (⅛ in.), in thickness above three-fourths inch (¾ in.), a deduction of one per cent (1%) shall be made from the specified elongation.

(b) For each decrease of one-sixteenth inch ($\frac{1}{16}$ in.) in thickness below five-sixteenths inch ($\frac{5}{16}$ in.) a deduction of two and one-half per cent. (2½%) shall be made from the specified elongation.

6. The three classes of open-hearth boiler plate and rivet steel shall conform to the following bending tests; and for this purpose the test specimen shall be one and one-half inches (1½ in.) wide if possible, and for all material three-fourths inch (¾ in.) or less in thickness the test specimen shall be of the same thickness as that of the finished material from which it is cut; but for material more than three-fourths inch (¾ in.) thick, the bending test specimen may be one-half inch (½ in.) thick:

Rivet rounds shall be tested of full size as rolled.

(e) Test specimens shall be subjected to a cold bending test, and also to a quenched bending test. The cold bending test shall be made on the material in the condition in which it is to be used, and prior to the quenched bending test the specimen shall be heated to a light cherry red as seen in the dark, and quenched in water, the temperature of which is between 80 deg. and 90 deg. Fahrenheit.

(d) Flange or boiler steel, firebox steel and rivet steel, both before and after quenching, shall bend cold 180 deg. flat on itself.

7. For firebox steel a sample taken from a broken tensile test specimen shall not show any single seam or cavity more than one-fourth inch (¼ in.) long in either of the three fractures obtained on the test for homogeneity as described below in paragraph 12.

8. The standard test specimen of 8-in. gaged length shall be used to determine the physical properties specified in paragraphs Nos. 4 and 5.

10. For material ¾ in. or less in thickness, the bending test specimen shall have the natural rolled surfaces on two opposite sides. The bending test specimens cut from plates shall be 1½ in. wide, and for material more than ¾ in. thick the bending test specimens may be ½ in. thick. The bending test specimens for rivet rounds shall be of full size as rolled. The bending test may be made by pressure or by blows.

11. One cold bending specimen and one quenched bending specimen shall be furnished from each plate as it is rolled. Two cold bending specimens and two quenched bending specimens will be furnished from each melt of rivet rounds. The homogeneity test for firebox steel shall be made on one of the broken tensile test specimens.

12. The homogeneity test for firebox steel is made as follows: A portion of the broken tensile test specimen is either nicked with a chisel or grooved on a machine, transversely about $\frac{1}{16}$ in. deep, in three places about 2 in. apart. The first groove should be made on one side, 2 in. from the square end of the specimen; the second 2 in. from it on the opposite side; and the third 2 in. from the last, and on the opposite side from it. The test specimen is then put in a vise, with the first groove about ¼ in. above the jaws, care being taken to hold it firmly. The projecting end of the test specimen is then broken off by means of a hammer, a number of light blows being used, and the bending being away from the groove. The specimen is broken at the other two grooves in the same way. The object of this treatment is to open and render visible to the eye any seams due to failure to weld up, or to foreign interposed matter, or cavities due to gas bubbles in the ingot. After rupture, one side of each fracture is examined, a pocket lens being used if necessary, and the length of the seams and cavities is determined.

15. Variation in cross-section or weight of more than 2½ per cent. from that specified will be sufficient cause for rejection, except in the case of sheared plates, which will be covered by the following permissible variations:

(e) Plates 12½ lbs. per square foot or heavier, when ordered to weight, shall not average more than 2½ per cent. variation above, or 2½ per cent. below the theoretical weight.

(f) Plates under 12½ lbs. per square foot, when ordered to weight, shall not average a greater variation than the following:

Up to 75 in. wide, 2½ per cent. above or 2½ per cent. below the theoretical weight.

75 ins. and over, 5 per cent. above or 01.5 per cent. below the theoretical weight.

(g) For all plates ordered to gage there will be permitted an average excess of weight over that corresponding to the dimensions on the order equal in amount to that specified in the following tabie. [Table not reprinted.—Editor.]

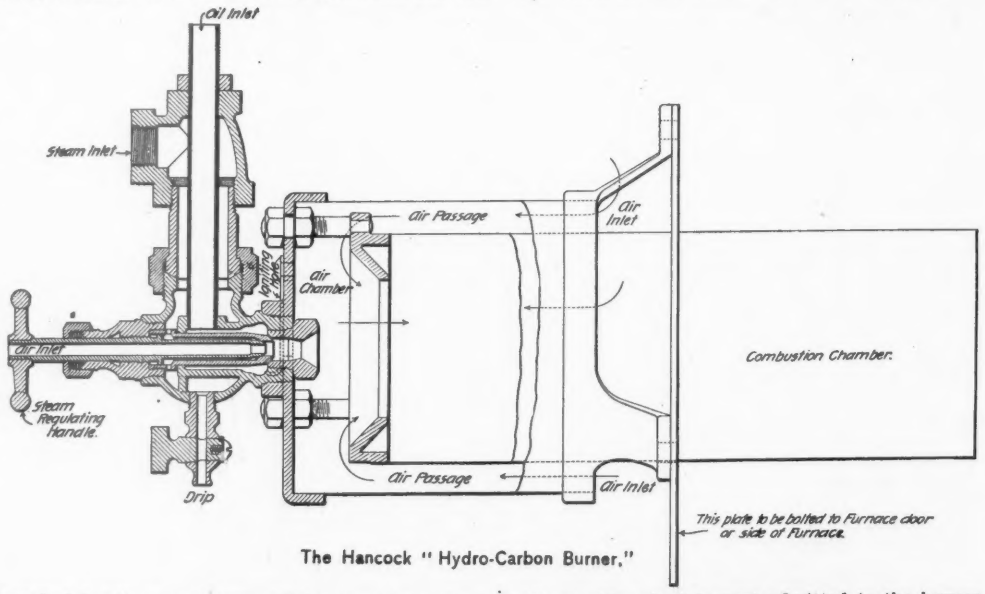
The Hancock "Hydro-Carbon Burner."

The illustration shows a recent design of a burner using a mixture of liquid fuel, steam and air to give a very hot flame, which can be applied to a variety of uses where a high degree of heat at a particular point is required. It also serves secondarily to consume, in part, the unburnt waste gases in a furnace. Crude petroleum, refined oil, naphtha, or gas, can be used as the fuel. Its special feature is the combustion chamber, and the arrangement for the induction of air, as described later.

The burner consists essentially of an air chamber, a combustion chamber and inlets for oil, steam and air. When ready for use, the combustion chamber is inside the furnace, the sheet-iron plate on one end of this chamber, as shown, being bolted either on the furnace door or on the side of the furnace. If atatched to the former, both the steam and oil supply pipes must have flexible connections to permit the door to be opened and closed. When the sheet-iron plate is bolted in position, it makes a close fit between the plate and the furnace, which prevents the entrance of air to the furnace except through the air inlets of the burner.

The following operations are necessary in starting the flame in the burner after it has been put in place and the connections made. The valve which controls the amount of steam entering the chamber is first closed; this valve is worked by the "steam regulating handle," as shown in the illustration. The valve in the steam pipe is then opened. A small quantity of oil is next admitted to the burner through the oil inlet and is ignited through a small covered igniting hole, after which the valve in the oil supply pipe is opened a sufficient amount to admit enough oil to keep the flame burning. After this, the "steam regulating valve" is opened and dry steam is admitted until perfect combustion of the oil, steam and air (which is drawn in as indicated on the illustration) is obtained. The steam, being rich in hydrogen, aids materially the combustion, besides blowing these products into the air and combustion chambers. An incandescent flame (as the blue flame of a Bunsen burner) and the absence of smoke indicate perfect burning, which can be maintained by a proper regulation of the steam and oil supply; and when once properly started, it does not require further attention.

The rush of steam through the air chamber and the natural draft provided for the furnace keep the flame from the air chamber. It may be noted that in addition to the air supply through the passages about the air chamber, the steam regulating handle is hollow and the liquid fuel, steam and some air unite at the inner end of this handle. As the mixture is drawn in toward the combustion chamber, more air is gradually added and in the combustion chamber perfect combustion is obtained. The flame spreads out around the open end of this chamber and at least a part of the waste gases can thus be consumed. This apparatus takes advantage of the conditions—a good draft and a steam supply—to produce an intense heat with the use of but little fuel



The Hancock "Hydro-Carbon Burner."

and a consequent small expense of maintenance. It is made and sold by the Hancock Inspirator Co., now of New York.

Railroad Legislation in New York.

The New York Legislature has this year passed nine general laws affecting railroads. Chapter 198 gives an extension of time to street railroads which have not yet finished the construction of their roads laid out, but which have had a part completed and in operation for five years. Such corporations may under conditions laid down in this act, continue to operate their completed lines on securing the consent of the local authorities and of the owners of one-half the property abutting on the street.

Chapter 254 prescribes a schedule of dates for filing assessments of special franchises in the different cities of the State.

Chapter 549 amends the air-brake law. The use of coal jimmies is made unlawful, except upon certain short roads. The movement of freight trains not properly equipped with air brakes is made unlawful after Jan. 1, 1901 (instead of 1903); but the railroad commissioners may extend the time, though not beyond Jan. 1, 1902.

Chapter 740 repeals Subdivision 3, Sec. 49, Chap. 565 of 1890, concerning guard posts at the ends of truss bridges.

Chapter 476 amends the stock corporation law so as to permit bridge corporations to be merged with the railroad corporations running trains over them.

Chapter 739 amends the grade crossing law so as to give the railroad commissioners power, in the case of new roads, to determine the proportion of the cost of a crossing to be paid by the steam railroad, and also by the street surface railroad.

Chapter 482 amends the section of the railroad law relating to mortgages. Subdivision 10 is made to authorize the issue of bonds "for any of the lawful purposes" of the corporation.

Chapter 517 amends Section 65 of the railroad law so as to require claims for damages consequent upon the abolition of grade crossings to be filed within six months after the completion of the work.

Chapter 478 amends Section 103 of the railroad law; it enlarges the right of street surface railroads to abandon portions of routes.

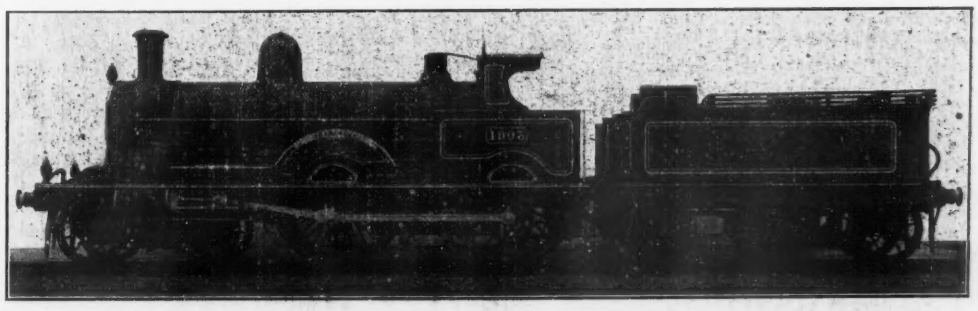
The bill introduced by Senator Ford modifying the tax law concerning special franchises at crossings of streets was not signed by the Governor, and therefore failed.

British Locomotives at the Paris Exhibition.

By J. P. P.

Among the locomotives shown by British railroad companies at the Paris Exhibition none will attract more attention than the fine four-coupled express locomotive, built to the designs of Mr. James Holden, for the Great Eastern Railway, heavy main line express traffic. Until recently the Great Eastern have been content with locomotives of moderate size and capacity for their express work, and the latest departure, which we illustrate by a reproduction from a photograph, is all the more interesting as Mr. Holden has challenged, in point of size and weight, the heavy machines built by Mr. Aspinall for the Lancashire & Yorkshire, and Mr. Wilson Worsdell for the North Eastern, both of which were described last year in the columns of the Railroad Gazette.

The four-coupled driving-wheels of this new engine (which bears the name "Claud Hamilton"—the Chairman of the Company—and the number 1900) are 7 ft. in diameter, and the driving splashers and the name plate are quite similar in appearance to those adopted by the London & North Western Railway.



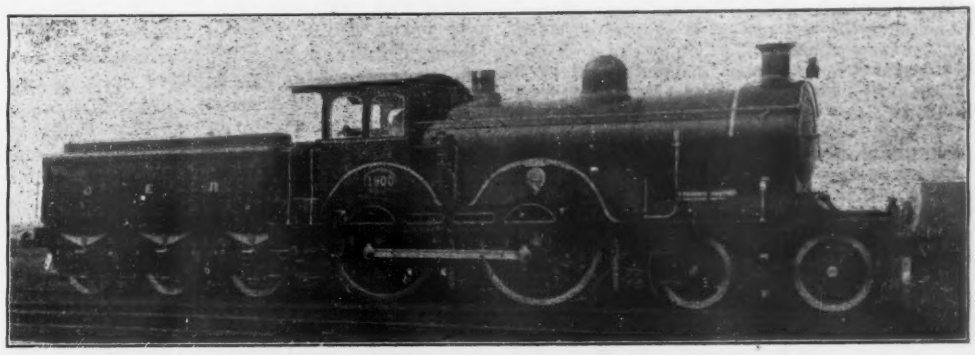
London & North Western Locomotive of the Class Shown at Paris.

The cylinders, with valve chests underneath, are 19 in. by 26. The boiler is 4 ft. 9 in. in diameter and contains 274 tubes, 1¾ in. in diameter, providing a heating surface of 1,516 sq. ft., which, added to the 114 sq. ft. of firebox surface, gives a total of 1,630 sq. ft. The boiler pressure is 180 lbs. to the sq. in. All these dimensions are a considerable advance on former Great Eastern practice. The engine is oil-fired on Mr. Holden's system.

The tender carries 2,790 gallons of water, 715 gallons oil fuel, and 30 cwt. of coal, and has a water scoop for picking up at speed.

It will be noticed that in consequence of the height of the boiler, the chimney has had to be shortened. The cab is also, for an English locomotive, exceptionally roomy. The engine is fitted with steam-sanding gear and the Westinghouse brake. No opportunity so far has presented itself of testing the work of the new type in actual practice, but it will doubtless be well able to deal with the heavy (but not exceptionally fast) express trains run by the Eastern Railway, between London and Norwich, Yarmouth, Cambridge and Doncaster.

The other illustration is a reproduction from a photograph kindly supplied by Mr. F. W. Webb, Chief Mechanical Engineer of the London and North Western Railway, and represents one of the same class as the Company's Paris exhibit. The engine exhibited is named "La France," and is the 4,000th locomotive built at Crewe. The dimensions are exactly similar to those of Mr. Webb's "Iron Duke" class, which have worked the very fast and heavy express trains of the L. & N. W. main line for some years with great satisfaction. The four-coupled driving wheels are 7 ft. in diameter, and the cylinders are 15 in. by 24 (two, high pressure) and 20½ by 24 (two, low pressure). The heating surface is 1,241.3 sq. ft. (tubes) and 159.1 sq. ft. (firebox); grate area, 20½ sq. ft.; weight in working order, 54 tons 8 cwts. (engine), and 26 tons 12 cwts. (tender.)



Great Eastern Locomotive Shown at Paris.

Electric Traction in France.

The Minister of Public Works of France has appointed a commission to inquire into the various questions which surround the application of electric traction to railroads. This commission is made up of 31 members, including three secretaries, nearly all of whom are engineers either of Ponts et Chaussées or of Mines, although there are several legal members. Among the members of the commission we find M. Solacroup, Chief Engineer of Material and Traction of the Orleans Railroad; M. Sauvage, Assistant Chief Engineer of Material and Traction of the Western Railroad; M. Sartiaux, Chief Engineer of Electric Service of the Northern Railroad; M. Mazen, Engineer of Material and Traction of the Western road; M. Auvert, Principal Electrical Engineer of the Paris, Lyons & Mediterranean, and M. Colson, the distinguished student of railroad matters, whose name as an author is familiar to our readers.

In a preliminary report pointing out the necessity for this investigation the Director of Railroads in the Public Works Department says that the problems as they occur on railroads now worked by steam are very different from those met on tramways, because of the heavy trains, high speeds and great power required. Furthermore, the economic difficulties are serious. The railroad companies are justified in doubting if they ought to make an extensive change considering its cost and considering the amount of material that would become useless. In America and in Switzerland much experimental knowledge has been acquired, but it applies only partly to the conditions in France. The relations of the railroads to each other and to the state in France complicate the matter seriously and it is questionable if existing agreements are favorable to proper enterprise in experiment. In Italy systematic experiments will be made on the two great systems, the Mediterranean and the Adriatic. These will cover a length of 348 kilometers of road and various methods will be tried, as storage batteries and three-phase current distributed at high tension by overhead wire and by a third rail on the systems of Ganz and Thomson-Houston.

The situation in Italy is peculiar, inasmuch as all coal must be imported and as furthermore there are considerable sources of water power in the Apennines. In France, however, the present sudden increase of industrial activity has caused a dearth of coal in some regions which is almost alarming and it is proper to inquire if water power cannot be used for working the railroads.

The commission will have to consider first a possible revision of the agreements and regulations under which the great companies are working, then the possible utilization of water powers.

Foreign Railroad Notes.

It is said that at the next meeting of the Diet of the German Empire, it will be asked to provide means for the establishment of a great testing laboratory for all kinds of materials. If this is done, it will probably be of great importance and value, not to Germany only, but to the whole civilized world.

The plans for the electric working of the railroad line from Genoa north through the Giovi Tunnel and pass have been approved by the Italian Government with unexpected promptness, with the recommendation to complete the work as soon as possible. The plan contemplates provision for moving 95 freight trains of 32 cars each daily in both directions, and 40 passenger trains and sundry freight trans on an older parallel line. There are to be 23 electric motors, of 544 horse-power for the freight trains and 840 for the passenger trains.

The building of the Trans-Baikal section of the Siberian Railroad will not be finished until July, 1900. It has cost more than was expected; and the total cost will not be less than 85½ roubles or 82,000 roubles per verst. The middle Siberian Railroad has also exceeded its estimated cost, and for two years the contractors have been paid, not in money, but in certificates which have been discounted by the banks at 18.5 per cent. discount. The embarrassed contractors have a poor chance for making a successful complaint against the management, because although these men reside in Irkutsk, a clause in the contracts with the Government requires that all suits shall be brought in the circuit court at St. Petersburg. The workmen have already been obliged to appeal to the Minister of Railroads for his assistance in getting their money. It is reported that on the Trans-Baikal section the workmen are lacking even the necessaries of life. The supply of water is insufficient and the quality is bad; the bread is not baked through, and the management scrimps the quantity of meal. In some of the camps sickness is unusually prevalent.

The Hungarian State Railroads instruct station agents that Indian corn of the new crops, whether in bulk or in sacks, from Oct. 25 till further notice, but not later than the end of February, takes precedence of other carload freight, being thus, apparently, classed as perishable freight.

According to a St. Petersburg newspaper, some of the Russian railroads contemplate putting an end to train robberies by removing the temptation thereto. When you buy your ticket you will deposit at the station of your departure the rest of your money, or the bulk of it, and receive an order for the amount on the station at your destination, which will be informed by telegraph and will hand you out the money on your arrival. As this will make it necessary to keep a stock of currency at the stations, and as many of these stations are in the wilderness, liable to attack, and as some actually have been robbed, we do not feel sure that this plan will succeed. But neither do we feel sure that it has been seriously proposed; for the Russian press censorship does not seem always to repress the invention of news.

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EDITORIAL ANNOUNCEMENTS.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to improvements. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Mr. W. F. M. Goss, Professor of Experimental Engineering and Director of Engineering Laboratories at Purdue University, has consented to act as a staff contributor for the Railroad Gazette. He assumes no editorial responsibility, but undertakes to write frequently and somewhat regularly. Ordinarily, Mr. Goss's articles will not be signed, but will appear in various departments of this journal. It gives the Directors of the Railroad Gazette much pleasure to make this announcement, and no doubt many friends of this journal and of Mr. Goss will have the same pleasure in reading it.

The Chronicle compiles the railroad gross earnings for April. The reports cover 117 railroads aggregating 102,004 miles, and shows an increase of $5,954,421 over the corresponding month last year, or 12.69 per cent. The New York Central leads with a gain in gross earnings of $503,116. Other roads making large gains are the Baltimore & Ohio, $479,014; the Northern Pacific, $373,491; the Chicago, Milwaukee & St. Paul, $347,704; the Great Northern, $329,760; the Mexican Central, $269,371, and the Canadian Pacific, $264,688. Only one of the larger roads shows a decrease, the International & Great Northern reporting a falling off of $78,490, attributable to the floods in Texas. Of the entire 117 roads, only 16 show losses. The gains of the New York Central are partly based on some losses in the corresponding month a year ago due to the delay in the opening of lake navigation. They also include $145,347 increase from the Fall Brook line taken over since the report of the year before. The increase of the 13 roads of the Northwestern and North Pacific group aggregates $1,560,000; the 11 roads of the Southern group report gains of $870,000; 18 roads of the Middle and Middle Western, $760,000; ten of the Southwestern, $410,000, and six trunk lines, $1,110,000. Aside from general activity of trade, three special advantages for the month are to be noted. The grain movement in the West was heavier than a year ago, there was a marked improvement in the live-stock movement and there was not the delay of 1899 in the opening of lake navigation. Among the disadvantages are the falling off of the cotton movement in the South, due to bad weather and floods; and labor troubles in various sections of the country. In winter and spring wheat the receipts at Western primary markets for the four weeks ended April 28 were 11 million bushels against 9¾ million bushels a year ago. Receipts of corn increased from 8,900,000 bushels to 16,573,000, a gain of 86 per cent. The receipts of wheat, corn, oats, barley and rye together aggregate 40 million bushels this year against 28 2-3 millions for the corresponding period of 1899. The contraction in the movement of cotton was directly the result of the smaller crop of this season. The shipments overland for the month were but 52,634 bales against 97,693 bales in 1899 and 92,560 bales in 1898. The receipts at Southern outports for the month of April, 1900, were 190,374 bales, against [illegible] last year and 262,429 the year before. The gains in railroad earnings are cumulative for several successive years. The increase of $5,954,421 for April this year follows an increase of $1,818,638 in 1899, and $5,967,869 in 1898, besides smaller increases in the years preceding.

Standard Specifications.

We began last week the publication of an elaborate set of specifications for iron and steel used in construction. Those which we have published so far have covered rolled steel, for bridges, buildings, ships and boilers, steel forgings, steel castings and wrought iron. Next week we propose to publish specifications for rails and splice bars; later will follow specifications for axles and tires. In this way we shall submit these specifications to the large body of civil and mechanical engineers who read the Railroad Gazette, and we hope that some of them will examine the specifications carefully and criticise, approve or disapprove.

Some of these specifications have this week been formally presented for discussion to the American Society of Civil Engineers at a regular meeting in New York City and to the American Society of Mechanical Engineers at the Cincinnati meeting. Some of them will be submitted to the Master Car Builders' and Master Mechanics' Associations at their annual conventions in June. Some of them will be submitted to the American Institute of Mining Engineers, the American Institute of Electrical Engineers and the Society of Naval Architects and Marine Engineers. No doubt they will also be brought before some of the British associations, and they will be discussed at the International Congress at Paris; finally, they will be taken up next October at a meeting of the American Section of the International Association. If the action at that meeting is favorable the specifications will be sent to all members of the Section for letter ballot, and then, it is hoped, they may be accepted by the Association itself.

The preparation of these specifications has been an affair of much work and cost. The work is that of a group of gentlemen in the American Section of the International Association. The cost is borne by that section, and it may not be out of place to say that the Railroad Gazette also has been at considerable expense in the matter and will be at still more.

The object of those who have put time and money into these specifications is not glory or profit, or a desire to impose their own opinions on other people. The object is to spread the truth for the good of humanity at large, and of this nation in particular. This is the spirit in which these gentlemen now ask the opinions, especially of their fellow citizens, on the work which they have done.

For specific information of the origin, nature and conduct of this work the reader is referred to the statement made by Prof. Merriman on another page of this issue, and he should carefully note that the committee in charge of the preparation of this set of specifications now numbers 34 members, and that they represent fairly the producer, the consumer and the consulting engineer.

The task taken up by the American Section is very difficult and no less important than difficult. Specifications that shall be widely accepted as standard must, in the nature of things, be a judicious compromise. The most that can be hoped for is that they shall combine the greatest amount of good practice and sanction no bad practice. It is too much to expect that they will satisfy everyone or that they will be ideally complete.

A set of standard specifications that may be widely accepted throughout the world and become authoritative will be of vast importance to American manufacturers of iron and steel from pig iron to finished machines and structures. They will be of like importance to consulting, designing and inspecting engineers and to engineers acting as commercial agents. We have lately seen a set of foreign specifications for wheels, axles and tires that include among approved makers only one American house. The specifications would, in themselves, rule out that one maker, and yet the physical and chemical properties prescribed in the proposed specifications of Committee No. 1 are actually higher than those laid down in this foreign specification. Similarly, the axle requirements of these foreign specifications are below those of Committee No. 1, and yet only one American maker will be admitted to compete under the terms of the specifications.

We have seen also a set of foreign specifications for rails brought into this market which, if adhered to, would rule out American practice, but the requirements are actually below those of the specifications proposed by Committee No. 1. These are examples of the kind of handicap that the American iron and steel maker is now subjected to when he goes into the foreign market, and they illustrate how much easier his lot in life would be if the effort to introduce a set of standard specifications could be made even moderately successful throughout the civilized world.

But after all, our great market is at home and by far the most valuable part of the work of this Association (if that work can be carried to success) will be in reconciling and adjusting our own differences of practice and requirements. The reader may see for himself what these differences are if he will take the trouble to examine the tables of synopses which we are publishing. Whether or not these specifications are ever adopted as international or even as American standards, making and discussing them is sure to do a great deal to unify the practice of the world.

The Canal Across the Isthmus.

Mr. Hepburn's Nicaragua Canal bill, which passed the House of Representatives, has been favorably reported by the Senate Committee, and there is at least a possibility, if not a probability, of its being passed through that body. We can only explain this as politics. No doubt the majority of the population of the United States think that a Nicaragua Canal ought to be built and that it ought to be controlled by the United States. Therefore, to pass a measure which embodies these ideas is a popular thing to do, and it is evident that the majority of the representatives do not dare to oppose a measure so popular, and it is probable that a majority of the Senate would not dare oppose it were it brought to a vote. Dignity, courtesy, international policy, duty toward the country, all suggest that we should wait until another session of Congress before taking this tremendous step, but a presidential campaign is due and all other considerations must stand aside.

A million-dollar commission was especially appointed by the President, acting under the instructions of Congress, to tell us all about the canal across the Isthmus. The majority of this commission are recognized by all who are competent to judge as singularly able and honest and as qualified for their duties. They have ransacked the archives of the Panama Canal Company; they have spent three or four months studying the matter on the ground; they have had hundreds of men at work for months making surveys and they still have many men at work on the Isthmus. They are not ready to report, but will be ready next winter. Ordinary business sense, as well as ordinary courtesy toward those gentlemen and toward the President, indicates that Congress should wait for the report of the commission unless some emergency has arisen since the commission was appointed. But no such emergency has arisen, except the presidential campaign. Therefore, it seems reasonable to say, that the action of Congress on the Hepburn bill is mere politics.

In fact, those members of the commission who appeared informally and as individuals before the Senate Committee declined (if we may trust the newspaper reports) to commit themselves as to the choice between Nicaragua and Panama. We do not know the opinion of the commission on this important question, and should not try to ascertain it, and should not tell if we knew. But it would be an even bet to-day that they will report in favor of Panama. We venture the assertion that if the matter were to be decided on engineering grounds alone the decision of the commission would be for Panama; but there may be political and business considerations which will turn the decision the other way. The concession under which the Panama Canal Company holds its privileges is actually burdensome and the owners have a costly equity, not alone in their concession, but the plant and in work done. Possibly it may be cheaper on the whole to keep clear of the Panama Canal. Certainly Congress and the public is not yet possessed of sufficient information to decide this important question.

On the other hand, there may be a bonus to pay to the holders of Nicaragua concessions, and there will be something to pay to Nicaragua and Costa Rica, and something for the work which has been done at Nicaragua, although apparently that work has little or no real value. So it would be business sense to wait and hear the statement of a responsi-

ble and impartial commission before committing ourselves to one or the other route.

Further, it is not wise or dignified to assume that we can settle this matter out of hand without any agreement with the European powers. We have plunged into world politics and have taken up new responsibilities and obligations toward all the world. A canal across the Isthmus is a matter of deep concern to every maritime nation and is closely involved in those international relations which we have assumed. Congress cannot, by passing an act, make the Nicaragua Canal or the Panama Canal or any other canal across the Isthmus "American." Germany, Great Britain and France, to say nothing of other powers, have some interest in the matter; and we must settle with them before we take or buy territory across the Isthmus and build and fortify a canal.

We have long held that there is only one reasonable status for the canal. It should be neutral, and its neutrality guaranteed by the great powers. We predict that the great powers will insist on this status. Several of them would like only too well to have an excuse to join hands against the United States on some sound and strong issue. It seems almost childlike to say that we can defy the world in this or any other matter of international interest.

These are some of the thoughts in mind when we say that dignity, courtesy, international policy and duty toward the country suggest care in any action that we may take.

We say nothing now of the uncertain estimate of the cost or of the unsolved engineering difficulties. At this moment the engineers of the commission are working in the swamps back of Greytown to try to make a practicable location of the eastern end of the canal. Strange to say, no such practicable location has ever been made. The House bill calls for a canal that shall pass the largest ships now afloat and provides that the cost of this canal shall not exceed 140 million dollars; but no detailed and authoritative estimate of the cost of a canal of such dimensions has ever been made, or at any rate, has ever been made public.

Park and Cemetery, which is a monthly journal, published in Chicago, devoted to landscape gardening, has an article in its March issue, written by Frances Copley Seavey, on the Embellishment of Railroad Station Grounds. Miss (or Mrs.) Seavey is the designer of the improvements on the grounds of the Michigan Central station at Ann Arbor, and her article gives views of the grounds at Ypsilanti and Niles. The principal feature of the paper is a protest against the use of too many flowers and showy features to the neglect of hardy vines, shrubs and trees which insure beautiful effects in winter as well as in summer. The writer says that a change for the better in this respect is already noticeable here and there. The roads mentioned in this article as being the most enterprising in gardening are the Pennsylvania, the Boston & Albany, the Philadelphia & Reading and the Michigan Central. We are not sufficiently familiar with all of these roads to say anything about their gardening in the way of comparison, but on one line, that of the Boston & Albany, we can say that the idea recommended in this article has long been carried out in practice. From the merely spectacular standpoint many of the Boston & Albany stations seem, indeed, to be lacking in flowers; but considering the year as a whole, and bearing in mind the primary purpose of only improving nature and of concealing art, the Boston & Albany's scheme is highly satisfactory. And while the idea of changing natural conditions as little as possible is closely adhered to (as has been told by Mrs. Blodgett in the Railroad Gazette) the B. & A. is by no means stingy in care and attendance. The combination of naturalness and beauty now observable at dozens of its stations is the result of intelligent and constant work.

The difficulty in answering all calls for freight cars during the busy season for several years past has resulted in much discussion in Germany, and the press has often called attention to the performances of our railroads in handling freight, and especially to the efficiency of the very large cars now so common here. In the Prussian Diet recently a deputy brought up the subject and intimated that it would be a grand thing for the Minister of Public Works to send commissioners here able to understand English, to study up the matter. This brought the Minister to his feet with the statement that there are but few of the State Railroad engineers who do not understand English; that in recent years no year has passed in which the Minister has not sent officials to America, and that he keeps a technical expert all the time not only in North America, but recently in South America also; "for America is a country from which railroad engineering and railroad management can still learn much." The Minister said that 100 30-ton (66,000 lbs.) cars had been built for the State railroads a few years ago, but that the shippers objected to them, finding them unsuitable to their methods and customs of trade, and therefore these cars had been transformed into platform cars. That there might hereafter be an advantage in a limited number of very large cars was possible; but the present requirements are for the standard in use.

Chili, which is a narrow strip of land between the Andes and the Pacific, and thus ill-situated for a railroad system, has 1,375 miles of State railroad, 306 miles being narrow-gage lines. These have cost on the average about $55,000 per mile. When they were built a scale of rates was adopted. Then the national currency was in silver, and silver was worth rather more than gold. But silver fell, and the national currency became a depreciated paper, worth less than silver, even, and meanwhile the rates remained unchanged, while prices of materials, etc., naturally rose as the value of the currency fell. One of the results is that the working expenses in 1897 absorbed 97 per cent. of the earnings and in 1898 93 per cent., leaving an insignificant return on the capital invested.

NEW PUBLICATIONS.

The Trackman's Helper. Revised 20th Century Edition. By J. Kindelan, Late Roadmaster, Chicago, Milwaukee & St. Paul Ry. Revised by F. A. Smith, Editor "Roadmaster and Foreman"; F. R. Coates, Late Roadmaster, New York, New Haven & Hartford, and Jerry Sullivan, Division Roadmaster, Choctaw, Oklahoma & Gulf. Chicago: Roadmaster & Foreman, 1900.

Mr. Kindelan's little book has been known and used for a good many years and it is hardly necessary to say anything of it now other than to announce the fact that this revised edition has been issued. We are not informed as to the extent of the revision, but the volume now contains 334 pages and a considerable number of illustrations. It treats in some detail the whole subject of maintenance.

Railway Signaling Club; Proceedings for 1899. Chicago: Published by the Club.

The title page of this pamphlet is inscribed Chicago, as above noted, but the office of the Secretary, Mr. C. O. Tilton, is at West Milwaukee, Wis. The pamphlet gives a list of the officers, a copy of the constitution and by-laws and a list of members, which is based on the records of March 1, 1900. The book is made up of the proceedings of the meetings at Philadelphia in February, at Chicago in April and September, and at Boston in November.

Mechanical Ventilation and Heating by Forced Circulation of Warm Air. By Walter B. Snow.

The B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass., sends us a pamphlet with the above title, being a lecture delivered last November at Sibley College, Cornell University. The company informs us that copies may be had on application. The pamphlet contains 32 pages with many illustrations, and the reader will at once understand that it is a good summary of the art, coming as it does from Mr. Snow.

TRADE CATALOQUES.

Dustless Roadbeds.—The Q. & C. Co. sends a pamphlet entitled "The Dustless Roadbed." That company is exploiting the Nichol and Mattern patents for the use of oil to lay dust on railroads. The company grants licenses under the patents, including the use of oil, and also the right to build and use patented machinery. The company is also prepared to furnish men to instruct railroad employes in the use of the machinery. The pamphlet states a considerable number of advantages to be derived from the use of oil on the ballast. A flat car can be equipped for sprinkling at a cost of about $250. Two men can work the car and usually cover 3½ to 4 miles an hour. The pamphlet says that there are at present several thousand miles of oiled tracks. These include the running tracks of the Philadelphia, Wilmington & Baltimore between Baltimore and Washington, some track on the same road north of Baltimore, those tracks of the New York Division of the Pennsylvania which are ballasted in cinder and gravel, some parts of the main line of the Pennsylvania and of the Amboy Division, a considerable mileage on the West Jersey & Seashore, 400 miles on the Boston & Maine, several hundred miles on the Boston & Albany, 150 miles on the Delaware & Hudson and nearly 200 miles on the Long Island. Other roads that made trials of oil in 1899 were the Union Pacific, Southern Pacific, Fitchburg, New York, New Haven & Hartford, New York Central, Wisconsin Central and the Burlington & Missouri River.

Twist Drills, Reamers, Milling Cutters, etc.—The Standard Tool Co., of Cleveland, O., sends a pamphlet designed to advertise its famous products. The pamphlet is printed in English, French and German, and shows twist drills, reamers, chucks, sockets, spring cotters, taps, flat spring and rivet keys, milling cutters and the Standard twist drill grinding machine. Besides being a nice list of tools the pamphlet has a particular interest in being, so far as it goes, a technical dictionary, as it gives the French and the German equivalent for the English names. The editor at least knows how convenient such a list is.

Locomotive Injectors.—The Hayden & Derby Mfg. Co., 85 Liberty St., New York City, send a new catalogue, 28 pages, 9 in. x 12 in., illustrating the Metropolitan "1898" locomotive injectors. The catalogue shows the various types and gives specifications of sizes of pipe connections and details of repair parts. The same pamphlet shows other special parts, as strainers, check valves, etc. In addition to the usual price list will be found detailed tables of capacities at various temperatures of feedwater and various steam pressures. The catalogue will be sent on application.

Snowplows.—The Russell Snowplow Co., Tremont Building, Boston, Mass., sends a new illustrated pamphlet showing the Russell snowplows and flangers. The construction of these snowplows is well known to our readers. The company says that in the last two years it has booked more orders by the middle of October than it could handle in due season, it therefore urges customers to place their orders early.

The Railway Signaling Club.

The regular meeting of this Club was held at Chicago on Tuesday of last week, Mr. W. J. Gillingham of the Illinois Central, presiding. The first discussion was on the paper of Prof. Smart, published in the Railroad Gazette last week. All of the speakers spoke favorably of Mr. Smart's recommendations. A text book on signaling is needed, and the establishment of signaling courses in the technical schools generally might be expected to lead to the production of such a book. Replying to questions, Prof. Smart said that the railroads were now asking for more technical graduates than the schools can supply. At Purdue, instruction has been given in signaling for two or three years. About 30 men each year take the course, which is based on the outline given by Mr. Smart in his paper. There is a 60-lever interlocking plant near the University which the pupils visit. Students have no false pride, and are willing to begin active life as repairmen and inspectors.

Mr. Camp called attention to the importance of educating young men in the questions concerning the operating of trains in connection with signals. Mechanical and engineering points may be learned in school, but train running requires a great deal of study.

On Mr. Vernon's paper, which also was published last week, most of the views expressed were adverse. The speakers were Western men, who have long used derails, while Mr. Vernon lives in the East where this device is not so common. The first criticism was from Mr. Hobson (A. T. & S. F.), who was not present, but sent a letter. Mr. Hobson said, in substance:

"Abandonment of the derail is not the proper remedy for the delays spoken of by Mr. Vernon. At junctions like those he mentions it is generally true that one of the trains is considerably less important than the other, and can be so scheduled as to have time to make a second stop. Suitable guard rails will keep trains from running into the ditch. A derail is not more dangerous than a facing point switch. It has but one point, and this is directly held in place by two, and usually three independent rods. A train turned on to a diverging track is likely to be overturned by the sharpness of the curve, and it may run into another train standing on said track. Mr. Vernon cannot recall a case where a derailing switch prevented a collision; but at one of our interlockings last year an engineman was derailed at a speed of 30 miles an hour and was stopped in 150 ft. Before he stopped an express went by on the other road at high speed. Mr. Vernon's plan would be good (though electric locking would be cheaper and simpler than detector bars), provided enginemen were perfect and never got killed. But as long as mankind is imperfect, derails afford the only suitable protection. Their merits cannot be shown in statistics, as the moral effect on the enginemen is important, making them careful not to get caught.

Mr. Elliott agreed with Mr Hobson. If an engineman will disregard a signal at a derail he will disregard the rear stop signal. The problem is not to get signals that the engineman can see, but to get him to obey those which he does see. One of our enginemen ran off a derail without even shutting off steam. The interlocking had been in use only three weeks and the engineman said that he never thought to look for the signal. Trains will not generally run on to the crossing after being derailed. I know of only three instances where this occurred, and in each of these the trains on the transverse track had not reached the crossing. These trains ran over because the guard rails were too long. We now use them only 120 ft. long, the derail being 400 ft. from the crossing. A derail is as necessary at a high speed crossing as at a drawbridge; it is worse to plow

through a passenger train than for an engine to drop into a canal.

Mr. Goodman (C., C., C. & St. L.): We have, in some cases, put in two derails, one 50 ft. from the crossing, and the other 400 ft. away.

Mr. Elliott related an incident showing the difficulty of getting enginemen and trainmen to thoroughly comprehend and obey signals. A freight train broke in two and the forward portion ran on some distance beyond a crossing. It was gone so long that the signalman allowed a train to pass on the transverse road, depending on the dwarf signal to stop the returning portion of the broken freight train, but the engineman came back and ran with entire disregard of the signal, although there was a derail there.

Mr. A. W. Hall: The Boston & Albany does not use derails.

The Chairman, replying to a question, stated that Illinois requires derails both sides of a crossing, on double track as well as on single. In the normal direction the derail is to be placed 400 ft. away; in the other direction 150 ft.

Mr. Hovey, replying to questions, gave information concerning the Taylor interlocking machine, in which the switches and signals are worked by electric motors. A plant has been installed with a low-speed motor. It has only four gear wheels instead of six. The dwarf signal will be celluloid, inclosed in the casing, and will require no motor. The machine in the cabin will have two rows of levers and will be more compact than the old style.

Electric Driving in the Westinghouse Air Brake Works.

The works of the Westinghouse Air Brake Company, when built a few years ago, were equipped with a central boiler plant of 2,000 h. p. This boiler plant, which remains intact under the new system, supplied steam for a large number of air pumps, a heating system, and for 30 Westinghouse steam engines, varying from 5 to 225 h. p., so placed in the various departments of the works as to reduce the belting to a minimum. Steam was carried to the engines through underground pipes, but as the works were extended, the length of piping became excessive, and the loss by condensation was about 50 boiler h. p., and with the great increase in the business, the demand for steam at times taxed the capacity of the boiler plant. These considerations made it desirable to adopt a more economical system for power distribution, and the change from steam to electricity was made while the plant was running, and without delay in the ordinary work in the shops, as the engine belts were removed from the pulleys on the shafting, and the belts from the electric motors connected.

The only steam engines which remain permanently are two 10-h. p. exciter engines in the power station, and those necessary to operate the Roney stokers, air fan and rotary pump in the boiler room. All the space previously occupied by the 30 steam engines is now available for other purposes, as the entire power plant has been concentrated in one building.

A novel feature of this installation is the use of three 500-h. p. Parsons steam turbines, direct connected to generators. The new system places all the power and lighting machinery under one roof, and the single boiler plant with three turbo-generators furnishes light, heat and power to the entire establishment. The power station contains the three turbo-generators, two exciter units, the air pumps and condensers for the turbines, and two air compressors supplying air for testing air brakes and driving tools. The air compressors are arranged to be driven by belts from two 100-h. p. Westinghouse type "C" motors, and have 18¼ and 11¼ x 14-in. cylinders with inter-coolers, and each has a capacity of 688 cu. ft. of free air per minute. The air pumps and condensers are driven by a 50-h. p. type "C" motor, belt connected thereto. The generators, each of 300 kw., are bipolar, running at 3,600 r.p.m., the armatures being specially designed for high speed, and deliver two-phase alternating current at 440 volts and 7,200 alternations.

Power is applied throughout the departments of the works by Westinghouse type "C" induction motors, which are attached to the columns of the buildings, upon overhead timbers, or in any convenient place, and beyond an occasional oiling they require very little attention. The following list shows the number and capacity of each of the seven sizes of motors substituted in place of the 30 steam engines previously used:

Machine Shop.—Two 20-h. p., twenty-four 15-h. p.

Iron Foundry.—One 30-h. p., nine 15-h. p., four 10-h. p., two 5 h. p.

Brass foundry and blacksmith shop—Three 20-h. p., one 10-h. p., one 5-h. p.

Coal room—One 20-h. p., one 10-h. p.

Carpenter shop—One 20-h. p., one 10-h. p.

Pattern shop—One 10-h. p.

Experimental room—One 5-h. p.

Power station—Two 100-h. p., one 50-h. p.

One motor of 30 h. p. is used in the iron foundry for operating a fan, and the others are mounted in ways best suited to the requirements of each case. In the machine shop, which is a two-story building with line shafts running its entire length, several of the motors upon the first floor are bracketed against the columns of the building. The motors run at a speed of 1,120 r. p. m., and are belted to counter shafts, and thence to the line shafts in order to secure the desired speed of 112 r. p. m., which is an increase of 12 per cent. over the steam arrangement. In the second story the main shafts run at 172, 175 and 112 r. p. m., and the motors are put overhead where they are entirely out of the way. The brass room line shaft runs at 172 r. p. m., and is belted direct to the motor without a counter shaft. In the machine shop 23 sections of 3-in. shafting, 15 ft. 6 in. long, were dispensed with, and in the blacksmith shop, four sections. Four head shafts and eight counter shafts were also discarded in the machine shop by the substitution of electric motors.

The method of starting the motors is simple. Near each motor is a starting panel with a double-throw switch to which the four wires to each motor are connected. Motors up to 30 h. p. are started on the side circuits with 70 per cent. of the full voltage, and when they are up to speed, the switch is reversed and the full voltage is used. For larger motors auto-starters are employed.

In the machine shop the lines of shafting were continuous, 400 ft. long, running the entire length of the building, and each line was driven by an engine in the center of the building. Under the electrical system these lines of shafting were divided into four sections, with a separate motor for each, enabling part to be shut down if desired. The necessary power for each section was determined by indicators; first, cards were taken with one of the steam engines running all the machinery on one of the shafts. Shaft No. 1 required 58 h. p., which was the equivalent of four 15-h. p. motors. After averaging four indicator cards for the full load, the shaft was cut at the couplings, one section, estimated to require 15 h. p. at a time, being cut off, and other cards were taken as a check. In this way the proper situation of each motor was found. The machine shop required two 20-h. p. and twenty-four 15-h. p. motors. The total number of motors is 56, with an aggregate nominal capacity of 1,015 h. p., of which two motors of 100 h. p. each, and one of 50 h. p., are in the power station, leaving 765 h. p. as the aggregate for the manufacturing departments, as against 1,375 nominal horse power, and 949 actual indicated horse power, under full load of the steam engines required to do the same work.

The foregoing particulars outline the changes in the power plant of the Westinghouse Air Brake Company. The boiler plant remains intact, but three 500-h. p. turbo-generators supply electrical power and light in place of 30 separate steam engines. From February 1 to 7 of this year tests were made of the consumption of steam, and of the horse power under the old system. Between February 15 and 19, after the new electrical system was substituted, further tests were made on the same eight boilers. Care was taken to eleminate the uncertain quantities, and while some steam was used from these boilers for other purposes during the tests, the consumption was believed to be uniform in the separate series of tests with steam and electric driving. The pumps and other steam machinery requiring variable amounts of steam were isolated as far as possible, and were connected to other boilers. In the steam tests, all the engines were running except two of 50 h. p. and one of 150 h. p. for the dynamo. In the electrical tests the turbines furnished all the power except that for lighting the general office and running the arc lights in the foundry, and for the exciter engines.

The following table shows the comparative tests of the eight Babcock & Wilcox boilers for 24 hours from 6.30 a. m., Feb. 5, to 6.30 a. m. Feb. 6, while the works were operated by steam engines; and also for 24 hours from 6.30 a. m. Feb. 15 to 6.30 a. m. Feb. 16, under the electrical distribution of power. The days selected for comparison were fairly representative of the average work of the factory, which varies little from week to week:

	Steam Power, Feb. 5 and 6.		Electrical Power, Feb. 15 and 16.	
Duration of test in hours	11½	12½	11½	12½
Gage pressure in boilers per sq in.	113.2	107.4	114.6	114.9
Draught in column of water between damper and extreme left boiler in inches	.500	.509	.437	.245
Draught in column of water between damper and extreme right boiler, in inches	1.109	1.057	1.031	1.072
Draught in column of water in main stack, in inches	1.734	1.586	1.656	1.485
Water in steam loop, deg. Fahr.	195.1	192.7	177.1	177.1
External air, deg. Fahr.	33.3	33.5	38.6	28.6
Fire room, deg. Fahr.	63.2	61.0	65.7	60.0
Cold feed water, deg. Fahr.	35.3	35.0	45.0	41.5
Hot feed water, deg. Fahr.	163.5	160.8	159.5	171.6
Steam, deg. Fahr.	343.2	338.5	343.6	343.3
Moist coal consumed, in pounds	68,000	65,600	48,400	42,800
Moisture in coal, per cent.	3.30	3.08	5.75	5.27
Dry coal consumed, in pounds	65,756	63,580	45,617	40,544
Total dry refuse, in pounds	8,912	12,382	9,012	8,000
Total combustible, in pounds	56,844	51,198	36,605	32,544
Average water returned to boiler by steam loop, pounds.	20,016	21,358	5,429	5,902
Average water pumped into boiler by pumps, pounds	425,203	419,521	306,828	253,678
Total water pumped into boiler by pumps and steam loop, pounds	445,219	440,879	312,257	259,580
Dry coal consumed per hour, in pounds	5,718	5,086	3,967	3,244
Total dry refuse (proportion of dry coal) per cent.	13.5	19.4	19.75	19.73
Combustible consumed per hour, in pounds	4,943	4,096	3,183	2,604
Total actual evaporation of water from pump and steam loop (assumed 98 per cent. dry steam) in pounds	436,314	432,061	306,012	254,388
Net deductions from Preceding:				
Total equivalent water from and at 212 degs. Fahr., in pounds	479,974	470,318	333,447	274,681
Water actually evaporated per lb. of dry coal, in lbs.	6.63	6.79	6.70	6.27
Equivalent per lb of dry coal from and at 212 degs. F., in lbs.	7.22	7.39	7.30	6.77
Water actually evaporated per lb of combustible, lbs.	7.67	8.43	8.35	7.81
Equivalent per lb. of combustible from and at 212 deg. F., lbs.	8.35	9.18	7.30	6.77
H. P. on basis of 34½ lbs. water from and at 212 deg. Fahr. per hour	1,197	1,091	840	637
No. sq. ft. water heating surface per horse power	8.82	9.67	12.56	16.58
H. P. per sq. ft. of grate surface	5.98	5.45	4.20	3.18
Developed Electrical Horse Power:				
Neglecting lamps on switchboard			578	249

The following table gives a summary of the boiler tests under the steam and electric systems, showing the saving in coal and water by the electric plant, and also the saving and condensation returned by the steam loops:

	Steam. Lbs.	Electric. Lbs.	Lbs. Difference.	Saved. Per cent.
Combustible, day run	57,275	37,958	19,317	33.7
" night run	51,011	32,989	18,022	35.3
" Sunday	22,726	14,691	8,035	35.3
" Sun. P. M.	23,215	17,440	5,775	24.8
Equivalent water, day run	492,697	332,489	160,208	32.5
" " night run	476,388	279,756	196,632	41.2
" " Sun. P. M.	200,509	109,487	91,022	45.3
" " Sunday	183,683	961,124	87,559	47.6
Dry coal, day run	66,679	45,905	20,774	31.1
" " night run	62,386	40,660	21,726	34.8
" " Sunday	27,756	18,066	9,690	34.9
" " Sunday P. M.	31,239	22,098	9,141	29.2

The proportion of loop water pumped into the boilers during the day run under the steam system was 4 per cent. of the total quantity of water, but under the electric power system this proportion was reduced to 1.6 per cent. The water returned by the loops arose through condensation in the steam supply mains to the engines. Although the change of system of power distribution shows an extraordinary reduction from 4 to 1.6 per cent., due to the material reduction in the length of the steam mains, there is no doubt that this will be still further reduced when all the steam engines are removed, which was not the case when these tests were made. The above table shows an average saving of 32.2 per cent. in the amount of coal consumed, and of 41.6 per cent. in the amount of water evaporated under the electrical system.

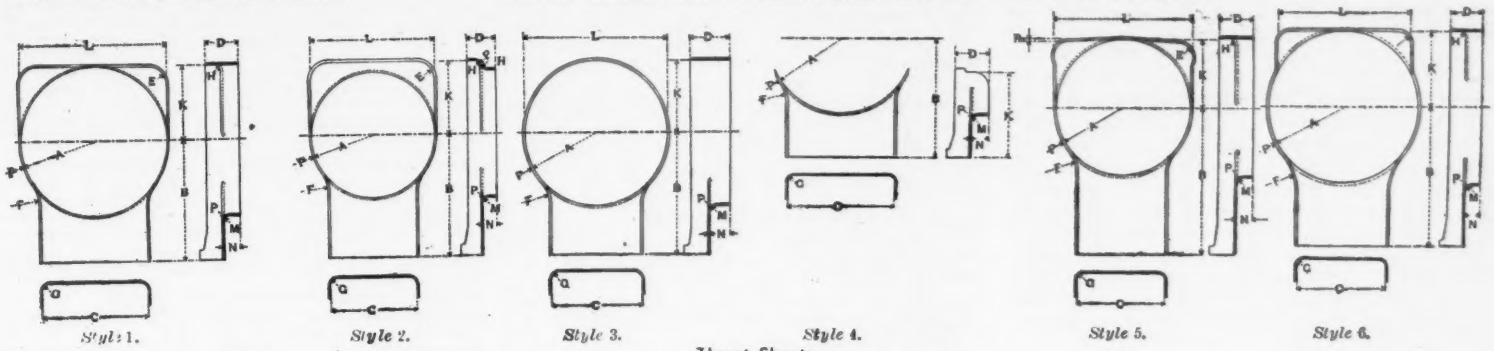
At the time that the test for the steam system was made, the 30 engines were loaded to very nearly their full capacity, indicating 949.12 h. p., whereas the total electrical horse power at the switchboard to replace this was under 600. In the night runs of the turbo-generators the power consumed was very small as compared with the day run, due to the fact that the works were practically shut down at 9.20 a. m. with the exception of the foundry, which is in continuous operation. A wattmeter gave the total number of watts, which, divided by the number of hours, gave the total number of watt hours. During the 11½ hours from 6.30 a. m. to 6.00 p. m. each day, the total electric horse power used, neglecting lamps, varied from 477 to 619, and during the night work was 249. These tests demonstrate the difference resulting from the two methods of power distribution under every day working conditions. They show that the turbines and motors have effected an economy of 40,000 lbs. of coal in 24 hours of continuous day and night performance, equal to over 32 per cent. of the total fuel consumed. This may be ascribed partly to the superiority of the entire electrical installation, as compared with the steam drive, and partly to the saving arising from the use of turbines instead of reciprocating steam engines for generating purposes, and also to reduced lost work by the better arrangement of the lines of shafting, made possible by the introduction of electric motors, and finally to the great reduction in steam pipe condensation.

Boiler Formers at the Richmond Locomotive & Machine Works.*

The engravings with the accompanying table on the facing page show an excellent method of filing and keeping records of certain locomotive boiler parts, the system having been devised by Mr. Millard F. Cox, Chief Draughtsman of the Richmond Locomotive & Machine Works. The forms here illustrated show one complete set of formers, which are all that would be required for an American locomotive unless it be one of unusual design. As shown, these are for the backheads, the throat, firebox flue, firebox dome sheet and dome base, all of which would be required if the boiler was so different from any previously built as to make it impossible to use any of the formers already on hand.

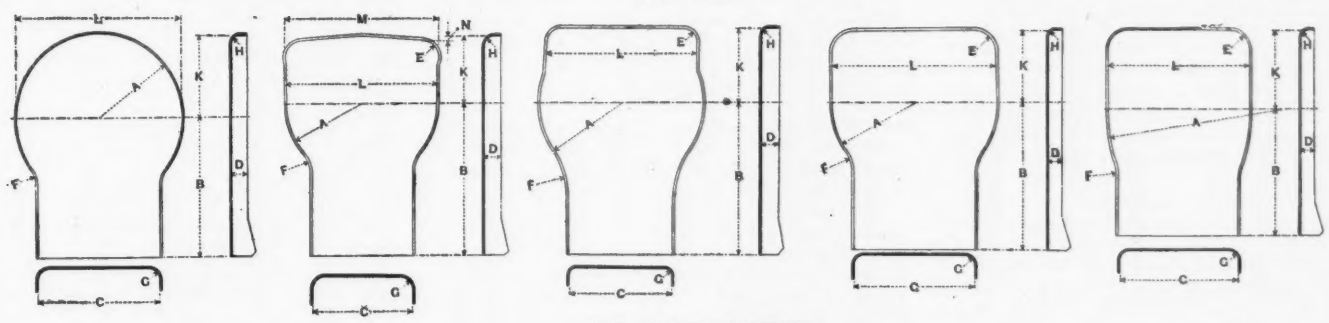
All of the sheets used are made the same size and clasped in book form with a stout cover. After the boiler sheets have been figured out and ordered and the preliminary designs settled upon, the formers are tabled up in the office book, from which two extra copies are made, one for the pattern shop and the other for the boiler shop. The two department foremen then agree as to the number of new formers required. In the table on the facing page, the record shows that the backheads of boilers numbered 6,350—75 were all made from the same former, having dimensions as given in the first line. The dimensions in the table indicate the variation of the sizes for the different parts of boilers in common use. Each form has a style number, there being, for example, six styles for the throat sheet, five for the boiler backheads and seven for the firebox flue sheets. The style number would be put in the blank space in the table under "Former used; remarks."

The letters themselves are all systematized, A in each case being for the radius, B for the height, C the width, etc., so that a comparison can be quickly made. This is the most carefully worked out scheme for handling boiler formers which we know of, and it is reasonably safe to say th t no more complete system has been devised.

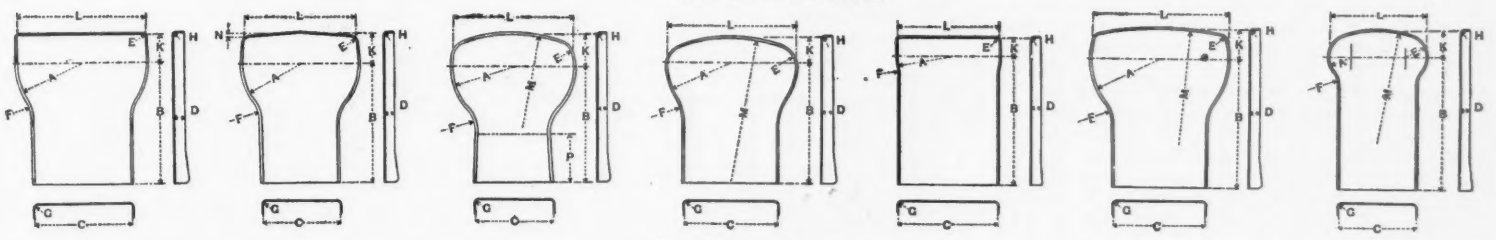


Style 1. Style 2. Style 3. Style 4. Style 5. Style 6.

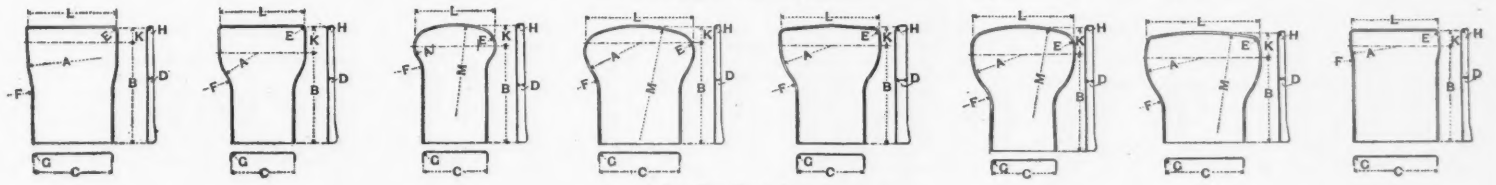
Throat Sheets.



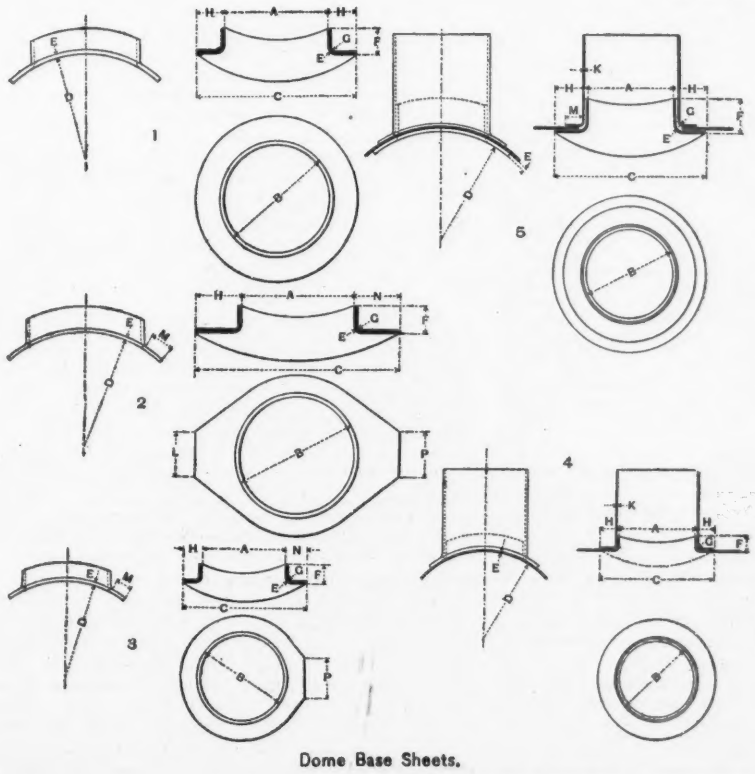
Boiler Back Heads.



Fire Box Flue Sheets.



Fire Box Door Sheets.



Dome Base Sheets.

Table of Back Head Formers.

Former used; remarks.	N.	M.	L.	K.	H.	G.	F.	E.	D.	C.	B.	A.	Style.	Shop number of boilers.*
	in.		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.		
....	....	....	57¼	31⅞	2½	4⅞	19	8 7/16	5⅜	48⅜	51½	69 7/16	3	6350-75
....	....	....	65¼	36¾	2½	2½	18⅝	....	7⅛	48⅜	52¾	32¾	1	6376-80
....	....	....	60⅛	30⅛	2½	2½	12 1/16	....	5⅝	39¾	40¾	30 1/16	1	6381-90
....	....	....	64	32	2½	4½	16½	....	5¾	48¾	47¾	32	1	6391-6400
....	....	....	68¼	34⅛	3	4½	26⅞	....	6	48⅛	46 7/16	34⅛	1	6401-20
....	....	....	60¼	30⅛	2½	4½	14 1/16	....	5¾	39⅝	49⅜	30⅛	1	6421-30
....	....	....	64	32	2½	4½	25	....	5⅞	38¾	45⅝	32	1	6431-50
....	....	....	63¼	31⅝	2½	4½	13⅛	....	5⅞	38¾	42⅞	31⅝	1	6451
....	....	....	56⅜	31½	2½	2½	15⅞	8½	6⅝	40⅛	63½	28 3/16	2	6452-55
....	....	....	65⅝	32 1/16	2½	2½	15¼	....	8	47⅞	54½	32 1/16	1	6456-70
....	1¾	61½	60⅜	27 3/16	4½	3 1/16	16⅛	6 1/16	8 13/16	39⅞	65 1/16	30 3/16	4	6471-80
....	....	....	55⅛	27 3/16	2½	2½	13 1/16	....	5½	49⅞	60 3/16	27 1/16	1	6481
....	....	....	64⅛	32 1/16	2½	4½	20 1/16	....	7¾	47⅜	53 1/16	32 1/16	1	6482-90
....	....	....	49¾	24⅞	3½	3½	12⅜	....	5¾	39⅞	59½	24⅞	1	6492
....	....	....	65¼	32⅞	2½	4½	13⅜	....	7 1/16	47⅝	49	32⅞	1	6493

* The shop number of each boiler is cast on its former.

BOILER FORMER SHEETS—SYSTEM OF FILING DEVISED BY MR. M. F. COX.

TECHNICAL.

Manufacturing and Business.

The Standard Paint Co., of New York and Chicago, have finished the large additions to their works and are now prepared to meet the increased demand for P. & B. products. The new main building is 240 ft. x 50 ft., of brick, two stories high, and will be used for making roofing and paper; the other smaller additions will be used for preparing P. & B. preservative and roof paints, electrical compound, armature varnish and insulation tape. The entire works are now run and lighted by electricity.

The New York Air Compressor Co. has received through the Chicago Pneumatic Tool Co. an order for a compound steam driven compressor to furnish 1,500 cubic feet of air per minute for the Motive Power Department of the New York Central & Hudson River Railroad.

The Sterlingworth new rolling mill at Easton has just been put in operation. The capacity is about fifty tons a day, and it will employ about one hundred men.

The Bethlehem Steel Co. has opened a branch office at Denver, Col. The company will be represented there by C. S. Burt, formerly President of the C. S. Burt Co., Ltd., of New Orleans. The latter company will continue to represent the Bethlehem Co. in New Orleans, but Mr. Burt's health having obliged him to change climate, he has established an office in Denver.

R. H. Weatherly, for the past four years Assistant Superintendent of the Scarritt Car Seat Works, has been appointed Assistant to Vice-President Clarence H. Howard, of the Shickle, Harrison & Howard Iron Co.

The Chicago Pneumatic Tool Co. has filed suit for infringement of patents against the Philadelphia Pneumatic Tool Co., and the Keller Tool Co., of Philadelphia.

Iron and Steel.

John W. Gates has retired as Chairman of the American Steel & Wire Co. John Lambert has resigned as President, and Isaac L. Elwood as Chairman of the Executive Committee. Alfred Clifford of St. Louis, heretofore Treasurer, succeeds Mr. Gates as Chairman. Wm. P. Palmer of Cleveland, O., formerly General Manager at Chicago, succeeds Mr. Lambert as President. Wm. Edenborn, heretofore Vice-President, is the new Chairman of the Executive Committee.

Four English iron and steel makers, R. Hedley, of Spennymoor; Henry Crowe, of West Hartlepool; Chas. T. Bagley, of Stockton-on-Tees, and F. M. Wistgarth, of Middleford, Eng., arrived in the United States May 11, and are reported here to make arrangements for rebuilding a number of bridges in South Africa, also to study armor plate making.

Chas. I. Nes, recently elected Secretary of the Standard Chain Mfg. Co., died at his home in York, Pa., May 10, after a brief illness with diabetes, at the age of 40.

Henry M. Curry, of Pittsburgh, Pa., for many years a partner of Andrew Carnegie, died at Atlantic City, N. J., May 5. He resigned from the Carnegie Board at the time Mr. Frick resigned. He was Vice-Chairman of the Carnegie-Phipps Co., Ltd., until the formation of the Carnegie Steel Co., Limited, when he became Manager of the Furnace Department, which position he held until quite recently.

The American Sheet Metal Co. is being organized with a capital of $50,000,000 to take over about 29 of the corrugated iron and cornice plants.

Many inquiries were received in New York May 14, from Mexico City, for quotations on some large lots of finished iron and steel, which are said to include, beside rails and other track material, a large quantity of corrugated sheet-iron, structural steel and iron beams.

An act passed by the last session of the Nova Scotia Legislature to encourage shipbuilding in that country, provides that after Sept. 1, 1901, all shipbuilding plants and iron and steel works shall be exempt from taxation, but pay instead a license fee. All ships built or registered in the province be exempt from taxation for 10 years.

Nickel Steel Rails on the Pennsylvania Railroad.

We have seen in a number of newspapers a statement, more or less elaborate, to the effect that the Pennsylvania Railroad's nickel steel rails, which are laid on the Horseshoe Curve, have been taken up. One newspaper says that "they seem to destroy the tractive power of engines by their excessive hardness." Others have copied this statement in various forms. We are told officially that there is not a word of truth in this report. On the other hand, the officers of the company do not expect to reach any conclusion with reference to this rail for some months to come.

East Boston Subway.

The Boston Transit Commission has asked for sealed bids for building Section B of the tunnel under Lewis St., in East Boston. Bids will be received at the office of the Commission, 20 Beacon St., Boston, until noon. June 14. Further particulars are given in our advertising columns. (April 13, p. 241.)

Analyses of Coal on the Long Island Railroad.

Mr. Charles N. Forrest, Chemist of the Long Island Railroad, sends us the following analyses of two varieties of coal, which have been tried on that road:

	No. 1. Semi-Bituminous. Per cent.	No. 2 Bituminous. Per cent.
Moisture	.67	.93
Volatile combustible	15.81	33.29
Fixed carbon	76.64	58.48
Ash	6.88	7.30
	100.00	100.00
B. T. U. per lb. coal	14,781	14,583

Mr. Forrest comments as follows on the two varieties of coal: "No. 1 is a non-coking coal, while No. 2 cokes strongly; and while No. 1 shows a higher calorific value and makes but little smoke, it is so fine that it falls through the grate and is drawn through the stack. No. 2 burns with a long flame and cokes readily. It will make a great deal of black smoke unless handled carefully, but a heavy fire can be carried on the grate, which is not broken by the tremendous draft of heavy engines. We find No. 2 suitable for all kinds of service and in any class of engines. It is a more economical coal for locomotives than No. 1."

The Taylor Signal Co.

This is a new company recently organized by Mr. Alvah W. Hall, formerly of the Hall Signal Co., to manufacture interlocking apparatus under the patents of John D. Taylor. This apparatus is wholly electrical, being worked by electric motors. Experimental plants have been in use for several years on the Baltimore & Ohio Southwestern and on the Illinois Central. The general office and works of the new company are at Buffalo, N. Y., and the Chicago office is at No. 1318 Monadnock Block.

The company has bought out the Taylor Switch & Signal Co., of Chillicothe, O., which was organized about five years ago, and which has hitherto controlled the Taylor patents. The experience of the above named roads with the Taylor interlocking is said to have been highly satisfactory, the cost of maintenance being found to be much less than with mechanical or electro-pneumatic interlocking. The officers of the new company are A. W. Hall, President and General Manager; George D. Morgan, Secretary and Treasurer; William G. Hovey, Superintendent, and John D. Taylor, Engineer. Mr. Hovey has been for eight years Superintendent of Electric Signals on the Chicago & Northwestern. The Directors are Charles W. Goodyear, Alvah W. Hall, Amos W. Morgan, Andrew Langdon, George D. Morgan, William L. Marcey, Horatio C. Harrower and John J. McWilliams, of Buffalo, and William G. Hovey of Chicago.

THE SCRAP HEAP.

A New Railroad in Greece.

Under date of April 7 Consul Skinner sends from Marseilles a statement taken from a French financial review that M. Theotokis, Prime Minister of Greece, has signed a convention with the representative of a syndicate of construction for the Oriental Ry., for building a railroad to connect Piraeus and Thessaly, and on to the Turkish frontier. This railroad will necessitate a loan to be contracted by the Government of 43,750,000 francs ($8,299,000) at 4 per cent.

An Awakened Conscience.

The G. P. A. of a certain railroad calls attention to a case of awakened conscience which he considers a "record-breaker." A few weeks ago he received from a clergyman a letter stating that a young man, who had recently been converted under his ministration, desired to make restitution to the railroads for a journey from Roanoke, Va., to Los Angeles, Cal., he having "beat" his way for the entire journey. The route was: Roanoke, Va., to Lynchburg, Va., via N. & W. Ry.; Lynchburg, Va., to Charlotte, N. C., via Southern Ry.; Charlotte, N. C., to Atlanta, Ga., via Southern Ry.; Atlanta, Ga., to Macon, Ga., and return, via Southern Ry.; Atlanta, Ga., to Birmingham, Ala., via Southern Ry.; Birmingham, Ala., to Meridian, Miss., via A. G. S. Rd.; Meridian, Miss., to Mobile, Ala., via M. & O. Rd.; Mobile, Ala., to New Orleans, La., via L. & N. Rd.; New Orleans, La., to El Paso, Tex., via Southern Pacific (A. S.); El Paso, Tex., to Los Angeles, Cal., via Southern Pacific (P. S.). The journey was made in the latter part of the year 1895.

The young man, a laboring man of limited means, would not be satisfied until he had relieved himself of the obligation he felt he was under to the different roads in question. The General Passenger Agent replied that he would accept for his road and the lines in interest the lowest regular rate in effect from Roanoke to Los Angeles, which was at that time $65.45, and that upon receipt of this amount would apportion it to each line. Almost by return mail a draft for the amount was received, and the distribution was made.

Carnegie Company Changes.

President C. N. Schwab of the Carnegie Co. on May 10 announced the appointment of H. B. Bope of the Sales Department to be Assistant General Sales Agent; H. J. Lindsay to be Assistant to the General Sales Agent, and F. H. Kindl, Structural Engineer of the Bureau of Engineering, to handle special technical matters under the supervision of John McLeod, Assistant to the President. James McKenzie, Assistant Structural Engineer in the Bureau of Engineering, is appointed Structural Engineer under the supervision of the Sales Department.

Proposed Bridge at Sydney, N. S. W.

The bridge for which competitive designs and bids are wanted August 1 by the Government of New South Wales, across Sydney Harbor, is to have two footways each 10 ft. wide, two roadways each 20 ft. wide, or one roadway 40 ft. wide; also 24 ft. in the clear for a double line of railroad. It is considered that the bridge should be a single-tier bridge, as the extra height to be surmounted by the railroad or road, as the case may be, might be an objection; but designs showing either the footways or the roadway, or both, overhead may be submitted, and will receive consideration. The bridge must have a clear headway of 180 ft. above high-water spring tides, for at least the middle 600 ft. of its length, and is to be of one span. Provision to be made for suitable connections with the Milson's Point Railroad and the existing Sydney and North Sydney streets. The steepest gradient for the railroad will be 1 in 35 and for the road 1 in 25. The bridge must carry a live load of 130 lbs. per superficial foot of roadway and footpath, and every part of the roadway must carry a moving load of 30 tons on two pairs of wheels and for a train on each railroad consisting of three of the heaviest class of engine and tender in steam, followed by loaded trucks; the engines and tenders to be taken as weighing 110 tons, with a length of 55 ft., and an axle load on drivers of 18 tons, the distributed load due to the loaded trucks to be taken as 1½ tons per lineal foot. The work on the bridge and approaches must not impede or obstruct the navigation of the harbor or the traffic on the streets on each side.

Bids must be addressed to R. R. P. Hickson, M. Inst. C. E., Under Secretary for Public Works and Commissioner for Roads; E. W. O'Sullivan, Secretary for Public Works.

Another Proposed Railroad in Honduras.

Consul Johnston of Utilla, under date of April 10, reports that there is a plan to build a railroad from Truxillo, Honduras, up the Roman River to Jutigalpa, in the State of Olaxcho, which will open up mahogany forests and mineral lands in the interior, as well as lands suited to the cultivation of bananas.

A New Railroad Opened in Salvador.

Consul Jenkins of San Salvador on May 20 reported the opening of train service between San Salvador, Santa Ana and Acajutla. The company will build a custom house for the Government and shippers will be benefited by about 50 per cent. reduction on freight between San Salvador and the coast.

The Locomotive Whistle in Paris.

The Minister of Public Works of France has recently addressed a letter to the Prefect of Police of Paris concerning the complaints about the abuse of locomotive whistles. The Minister recites that the Municipal Council of Paris in 1898 called attention to the abuse of the steam whistle within the limits of the city. He says that the use of the whistle was prescribed by an ordinance of Nov. 15, 1846, to provide for safety in working railroads. The Orleans Company, against which specific complaint was made by the Prefect, has instructed its enginemen to confine the use of the whistle to absolutely necessary occasions and not to make the blasts too loud or too long. But it is impossible to suppress entirely the use of the whistle within the city, which, in fact, is prescribed by laws and regulations in the interest of public safety. As to the proposition to replace the steam whistle by some other signal which would answer the same purpose, the advantages would not compensate for the cost of the change. Moreover, there seems to be no practicable substitute for the steam whistle.

"Preaching in the Dining Car."

On account of the lateness of the spring, or for some other reason, the supply of railroad news at Chicago is very scanty just now, and one of those prolific reporters who always issue at least two-thirds of a column of matter daily, whether there is any news or not (and two columns on Sunday) has evolved a story about the probable establishment of religious services on through trains which run on Sunday. This is said to be just now one of the stirring questions that is agitating the general passenger agents of the "big western railroads." One of the roads has even gone so far as to "consider" the plan; but beyond this the reporter's tale is most delightfully vague. As everyone knows, a ride through the fertile prairies of Indiana and Iowa is somewhat more monotonous on Sundays than on other days, and, according to the reporter, there is now a well-defined desire on the part of some general passenger agent to take measures to break "the monotonous bumpety-lump" of Sabbath days' journeys, and incidentally to augment profits by securing the custom of people who have scruples against traveling on Sunday. After cooking up his story, the reporter tried to get opinions on the plan from various passenger officials, but he found rather dry picking. The most practical criticism that he drew out was from a G. P. A. who thought that the expense of hiring the preachers would be a severe burden on the treasury of the railroad company.

Iron Production in Japan.

The production of iron in Japan, though as yet small, is increasing every year. The output for eleven years to 1898 was as follows:

	Pounds.		Pounds.
1887	33,335,784	1893	37,132,819
1888	39,724,530	1894	42,431,416
1889	43,786,185	1895	56,324,319
1890	45,878,500	1896	59,765,303
1891	37,799,927	1897	61,114,480
1892	41,197,128		

In 1897 several new iron mines were opened, and the production has increased in proportion. Importation of iron also continues to increase, though a heavy falling off was observed last year in bar and rod iron, rails, iron nails, and steel, to say nothing of machinery and locomotives. The quantity and value of iron and steel imported last year, compared with the preceding year, is as under:

	Pounds.	Value.
1898	585,387,511	$6,475,290
1899	307,438,661	5,641,847

The falling off in the importation of iron and steel last year was not due to increased production of the metals in Japan, but is to be accounted for by the depression in the manufacturing industry.

Engineering by Popular Vote.

The Swiss outdo us in their democracy. In the city of Berne, recently, it was a question whether to continue to work a street railroad by compressed air or to substitute electricity as the motive power. This was submitted to a vote at an election! For electricity, 1,964; for air, 1,772. A Berne newspaper commenting on this says: "With us every voter is born an engineer; he decides not only where a bridge shall be built, but what the design of the bridge shall be; he determines not only that the municipality shall work the street railroads, but also how they shall be built, rebuilt and operated."

Brooklyn Pier Extension.

Governor Roosevelt has signed the bill to extend the East River pier line of Brooklyn between Hamilton Avenue and the New York and Brooklyn Bridge tower.

Hours of Duty in Prussia.

The Prussian railroads in connection with the investigation of accidents report the number of hours the employes involved had been on duty at the time of the accident. In 1899 there were 84 accidents. In 6 of them the employes had been on duty 1 hour, in 11 cases, 2 hours or less, in 3 cases, 3 hours, in 12 cases, 4 hours, in 11 cases, 5 hours, 10 cases, 6 hours, in 11 cases, 7 hours, in 5 cases, 8 hours, in 6 cases, 9 hours, in 3 cases, 10 hours, in 13 cases, 11 hours, in 3 cases, 12 hours; in no case more than 12 hours.

Iron in Siberia.

Siberia is usually looked upon as a new country, whose resources it is now first possible to develop. But in the Ural district the iron industry is already 200 years old. Charcoal has been the fuel used, but wood is getting scarce, and no considerable growth of the industry will be possible unless other fuel—coal or petroleum residuum—can be made accessible.

Railroads in Japan.

At the end of the fiscal year ending with March, 1898, there were 3,438 miles of railroad in Japan, with 802 stations, 1,103 locomotives, 3,811 passenger cars and 14,134 freight cars. Of the whole mileage, nearly three-fourths had been built in the last ten years and 43 per cent. in the last five years, and the greatest increase (nearly 500 miles) was in the last year.

Steamers on the Amazon.

The government of the state of Amazonas, Brazil, offers to guarantee 7 per cent. on a capital of $500,000 for a new line of river steamers on the Amazon, subject to the following conditions: 1. The concessionaire to establish a flotilla of 10 steamers to ply upon the rivers flowing through the state; 2. The tariffs to be fixed in agreement with the government; 3. The steamers to take cargo from the ports of the state, and also from Amazonian ports in Peru and Bolivia; 4. The service to be inaugurated within 12 months after signing the contract; 5. The government to have the right to send free three first-class and six third-class passengers on each steamer. The contract will be transferrable, with the approval of the government.

Technical Schools.

Worcester Polytechnic Institute.—The catalogue of the Worcester Polytechnic Institute contains much information of interest. The residences and occupations of all living graduates, nearly 800 in number, are given, from which it appears that they are engaged, almost without exception, in mechanical, civil, electrical, or chemical engineering for which they were trained at the Institute. The remarkable growth in all engineering and industrial operations, during the past few years, has greatly increased the demand for young men educated in technical schools. The Worcester school was one of the earliest of its kind founded. It has constantly added to its equipment and enlarged its facilities, so as to be able to meet the more exacting requirements of the present time. The President informs us that the demand for its graduates is now, and has been for some time, much greater than the supply, many members of the class to be graduated in June having already received appointment to desirable positions.

University of Minnesota.—Prof. J. J. Flather is now designing a dynamometer car which will be built by the Minneapolis, St. Paul & Sault Ste. Marie and used in locomotive tests. These tests will be made by the mechanical engineering department of the University, working in conjunction with the officers of the road.

LOCOMOTIVE BUILDING.

The Maine Central is in the market for four locomotives for freight service.

The Cornwall & Lebanon is having one locomotive built by the Baldwin Locomotive Works.

The Intercolonial, of Canada, is in the market for some mogul and compound consolidation locomotives. It is expected that 25 or 30 in all will be ordered.

The Huntington & Broad Top Mountain is having one engine built by the Baldwin Locomotive Works.

The Ashland Coal & Iron Ry. is having one engine built by the Baldwin Locomotive Works.

The Wiggins Ferry Co. has ordered from the Cooke Locomotive & Machine Co. two six-wheel connected switching engines with 18 in. x 24 in. cylinders, to be duplicates of the one built by the Cooke Company for the ferry company about a year and a half ago instead of one as stated last week.

The Union Pacific is having 60 compound consolidation engines built by the Baldwin Locomotive Works. They will burn soft coal; they will weigh 180,000 lbs. with about 160,000 lbs. on drivers. The tender loaded will weigh about 105,000 lbs. The total wheel base will be 23 ft. 11 in., the driving wheel base being 15 ft. 3 in. and the total engine and tender wheel base 53 ft. 5½ in. The centers of boilers will be 8 ft. 11½ in. above rails; the stacks will be 15 ft. 3 in. above rails. The fireboxes will have a heating surface of 219 sq. ft.; tubes, 2,148 sq. ft.; grate area, 33 sq. ft. They will have 57-in. in diam. drivers; 30 in. in diam. truck wheels; 9 in. x 10 in. driving axle journals; 6 in. x 10 in. truck axle journals; 6½ in. x 6½ in. main crank pins; 15½ and 26 in. x 30 in. cylinders; piston valves; straight top steel boilers, 200 lbs. working steam pressure; steel fireboxes, 72¼ in. front depth, 69¼ in. back depth; brick arches; rocking grate and drop plate grates; 306 iron tubes, 13 ft. 6 in. long, 2 in. outside diam.; smokeboxes, 71 in. in diam, and 66¾ in. long; single, 5 in. in diam., exhaust nozzles.

R. M. Miles is having built for the Cardenas & Jucaro, of Cuba, by the Rogers Locomotive Co., three mogul engines and one eight-wheel switching engine. The moguls will burn bituminous coal, or wood; will have 17 in. x 22 in. cylinders; 57⅝ in. in diam. cast iron driving wheels; 6½ in. x 8 in. driving axle journals, hammered iron driving axles; 14 ft. 6 in. driving wheel base; 22 ft. total wheel base; 72,000 lbs. on drivers, the total weight being 86,900 lbs.; 171 iron tubes, 10 ft. 8 in. long, with 2 in. outside diam.; grates, 57½ in. long and 33½ in. wide, and wagon top type boilers. The working steam pressure will be 140 lbs.; they will have cast iron spoke-center steel tired engine truck wheels 33 in. in diam., made by Rogers; tender frames will be of 6 in. steel channel, the trucks being square iron frame; wheels 30 in. in diam. cast iron spoke-center steel tired, made by Rogers; capacity, 1,800 gals. The eight-wheel switcher will burn bituminous coal, or wood; will have 17 in. x 22 in. cylinders; 42 in. diam. cast iron driving wheels; hammered iron axles; 6½ in. x 8 in. journals; 12 ft. 6 in. wheel base; weight on drivers, 95,000 lbs.; 169 iron tubes 11 ft. 8 in. long, 2 in. outside diameter; grates, 57½ in. long, 34 in. wide; straight top boiler, of steel, 56 in. in diam.; working pressure, 140 lbs. The tender will have a frame of 6 in. steel channel, square iron frame trucks 30 in. in diam., cast iron spoke-center steel tired wheels, made by Rogers. The capacity will be 1,800 gals.

CAR BUILDING.

The Pullman Co. is building 10 cars for its general service.

The Union Pacific is reported in the market for 2,500 freight cars.

Mobile & Ohio has ordered 300 gondola cars from the Mt. Vernon Car Co.

The Mobile & Ohio is having 300 cars built by the Mt. Vernon Car Mfg. Co.

The Lake Shore & Michigan Southern, it is rumored, is in the market for 1,500 cars.

The Vera Cruz & Pacific has ordered 10 stock cars from the American Car & Foundry Co.

The National Car Co., it is reported, has ordered 100 cars from the American Car & Foundry Co.

The Northern Pacific is reported in the market for 1,500 freight cars, 1,000 of which will be 70,000-lb. capacity box cars.

The Baltimore & Ohio Southwestern is in the market for 550 freight cars, 100 of which will be coal, 100 flat and 150 furniture cars.

The Penn Gas Coal Co. has ordered 206 cars from the American Car & Foundry Co. We noted 100 of these in our issue of March 23.

The Great Northern of Canada has ordered from the Illinois Car & Equipment Co. 150 box and 50 flat cars. The equipment includes Hutchins roofs, Hein couplers, Westinghouse air brakes, Sterlingworth brake beams, Bettendorf body and truck bolsters, Griffin wheels, steel axles, M. C. B. cast iron journal boxes.

The Illinois Central coal cars, 1,000 of which were ordered from the American Car & Foundry Co. and 500 from Haskell & Barker, as noted in our issue of May 4, will be of 80,000 lbs. capacity, weight, empty, 31,200 lbs., and will be 36 ft. long and 8 ft. 6 in. wide. The sides will be 42½ in. high. Westinghouse air brakes, Universal bearings, Chicago couplers and Thornburg draft gear are specified.

BRIDGE BUILDING.

AUBURN, N. Y.—Bids are wanted May 21 for a steel bridge over the Owasco outlet on Lizette St., of two spans 110 ft. each, with two sidewalks and an 18-ft. roadway. D. F. Austin, City Engineer. (April 20, p. 261.)

BALTIMORE, MD.—The United Railways Co. has estimates for a bridge to cost $39,800 on the Lake Roland Division. D. B. Banks, Chief Engineer.

BELTON, TEX.—Reports state that the loss of Bell County bridges will probably reach $40,000.

BLOOMSBURG, PA.—The Columbia County Court has approved the report of viewers for a county bridge over Little Roaring Creek, between Columbia and Northumberland counties.

BRADFORD, PA.—The bond ordinance before the Council appropriates $3,000 for the Mechanic St. bridge; $1,200 for removing the present Mechanic St. bridge to Barbour St.; $5,110 for the Washington St. extension bridge, and $3,000 for the Forman St. bridge. (March 23, p. 191.)

BURLINGTON, IA.—The narrow gage line of the Chicago, Burlington & Quincy between Burlington and Oskaloosa, Ia., is being changed to standard gage. Several new bridges will be built.

CANAL, DOVER, O.—The Cleveland, Lorain & Wheeling trestle over a branch of the Tuscarawas River five miles north of this place collapsed with a freight train May 8. It will be replaced with a steel structure.

CEDAR RAPIDS, IA.—A subway to cost about $37,000 is proposed at North Third St. A subway is also proposed at Third Ave. A viaduct is reported contemplated at Avenue A, all to cross the Chicago & Northwestern tracks.

CHARLOTTETOWN, P. E. I.—Bids will be wanted in about three months for a steel bridge on nine stone piers over the Hillsborough River, near Charlottetown for the Prince Edward Island Ry. Estimated cost, $1,000,000.

CHITWOOD, ORE.—Bids are wanted June 6 for a bridge across the Yaquina River at the mouth of Hay's Creek, near Chitwood. J. H. Lutz, Lincoln County Auditor, Toledo, Ore.

CINCINNATI, O.—The Harrison Ave. viaduct is before the Board of Public Surveys. The viaduct is to begin at Barnard Ave. and extend to State Ave., and is estimated to cost $250,000.

CLEVELAND, O.—The New York, Chicago & St. Louis has contracted with the King Bridge Co. for three high viaducts of about the following lengths: One 1,400 ft. and one 1,500 ft., both single track; one 700 ft. double track.

See also Tennessee Roads in Railroad Construction column.

COHOES, N. Y.—The Delaware & Hudson is reported ready to build an overhead crossing on Ontario St. The bridge will consist of three spans, one of about 54 ft. and two of about 40 ft. each.

See also New York Central in Railroad Construction column.

DUBLIN, ONT.—Hibbart Township Council has ordered bids received for a steel bridge to replace Whyte's bridge on Center Road. James Jorelan, Village Clerk.

DELANCO, N. J.—The Groton Bridge Co. has the contract for the 400-ft. steel bridge across Rancocas Creek, between Delanco and Riverside, at $15,050. The other bidders were:

Berlin Iron Co., East Berlin, Conn.	$15,774
Wrought Iron Bridge Co., Canton, Ohio.	17,000
B. F. Sweeten & Son, Camden, N. J.	16,107
Dean & Westbrook, New York.	16,960
New Jersey Iron & Steel Co., Trenton, N. J.	15,475
Canton Bridge Co., Canton, Ohio.	16,600
F. R. Long Co., New York.	16,800
Toledo Bridge Co., Toledo, O.	16,500
W. H. Gulick, Phoenixville, Pa.	17,900
Nelson & Buchanan, Chambersburg, Pa.	16,200

ERIE, PA.—The Pennsylvania will replace the wooden bridges on the Philadelphia & Erie with steel as required. Part of the work will be done this year.

FAIR OAKS, CAL.—We are informed that the proposition to build a steel bridge 350 ft. long over the American River at Fair Oaks will probably assume definite shape in July. Wm. B. Hamilton, County Clerk.

FREDERICTON, N. B.—The provincial Government is receiving bids for building the upper corner bridge near Sussex, Kings County.

FULTON, N. Y.—Wm. B. Hillick, Town Clerk, received bids on Wednesday of this week for the bridge over the Oswego River which is estimated to cost $102,000. (April 20, p. 261.)

HARRIETSTOWN, N. Y.—This town (Franklin County) will issue $17,000 of bridge bonds some time in December next for new work.

HOMESTEAD, PA.—The Union RR. is to build three bridges on the West Homestead extension. One is to span a creek near West Homestead and the other to span street crossings in Homestead. All are to be plate girders.

JASPER, ALA.—The Jasper Construction Co. has the contract for a steel bridge over the Sipsey River at Duncan's Ford, Walker County. It is to be 324 ft. long and 103 ft. above the river. (March 23, p. 191.)

The Commissioners of Walker County are considering another bridge over the Sipsey River at a cost of $12,500. Bids will not be asked until a number of smaller bridges in the county, recently destroyed by high water, have been replaced.

KANE, PA.—The Poplar St. bridge is again under consideration. Address J. E. Mullin.

LACOLLE, QUE.—The Quebec & Southern Ry. will build a bridge over the Richelieu River.

LAUREL, MONT.—A bridge across the Yellowstone River near this place was washed away by recent high waters. The bridge was recently finished at a cost of $10,000.

MOBILE, ALA.—A bill is before Congress authorizing the Mobile & West Alabama RR. to build bridges over the Warrior River between Walker and Jeffries counties and across the Alabama River between Marengo and Choctaw counties, Alabama.

MONTICELLO, LA.—The steel bridge which spans the Pearl River one mile below this place went down with the flood April 28. The structure was built 10 years ago at a cost of $16,240.

NEWARK, N. J.—The contract for the four-track bridge over the Passaic River on the Passaic Branch, New York Bay RR. of the Pennsylvania, near Newark, is let to Weand & McDermott of New York City. The bridge will have six stone and concrete piers.

NEW YORK, N. Y.—The proposed bridge over Newton Creek at Grand Ave., for which bids will soon be wanted, will have a draw 232 ft. long and 36 ft. wide. The roadway will be 21 ft. wide, accommodating two electric railroad tracks. There will also be two sidewalks each 6 ft. wide. The approaches will have a 3 per cent. grade. The draw will be 36 ft. above high watermark.

NORTH ADAMS, MASS.—The City Council has voted to issue $12,000 bonds with which to build two bridges in Beaver St. over the Hoosac River. One will be a low truss about 70 ft.; the other, a plate girder in two spans about 32 ft. each, with about 24 ft. roadway, and having walks on each side. The plans will be ready June 1. John H. Emigh, City Engineer.

OAKLAND, CAL.—A steel and concrete arch bridge of 80 ft. clear span is proposed over Commerce St. at Fourteenth St. at a cost of $15,000. Bonds will have to be issued to pay the cost. M. K. Miller is Consulting Engineer for the city of Oakland.

PATERSON, N. J.—The F. R. Long Co., New York, received contracts for three bridges for Passaic County. One is to cross the Passaic River from Thirteenth St. to Westside Park. The second is the West Brook bridge, on Hewitt Road in West Milford Township, and the third is known as the New Valley bridge in New Foundland. The other bidders were the New Jersey Steel & Iron Co., Toledo Bridge Co., Dean & Westbrook and the Berlin Iron Bridge Co.

PHILADELPHIA, PA.—The bids opened May 8 for completing the new Gray's Ferry bridge were as follows: Philadelphia Construction Co., $61,700, work to be finished in six months; Vulcanite Paving Co., Philadelphia, $56,000, time, three months; Pennsylvania Asphalt Paving Co., Philadelphia, $57,800, time, nine months; Alcatraz Paving Co., Philadelphia, $54,555 time, three months. (Mar. 30, p. 208.)

Complaints have been made to the War Department that the Kensington & Tacony RR. bridge across Frankford Creek is a hindrance to navigation. A drawbridge has been petitioned for.

PITTSBURGH, PA.—The County Commissioners May 10 let contracts for the superstructures of ten county bridges to the Pittsburgh Bridge Co., for $18,360.

Major Chas. F. Powell, Corps of Engineers, U. S. A., gave a hearing last week to the Sixteenth and Forty-third Street Bridge companies regarding their bridges across the Allegheny River.

PLYMOUTH, PA.—The Borough Engineer has been ordered to secure plans and specifications for the proposed Cherry St. bridge.

REVERE, MASS.—A Commission appointed by the Supreme Court has given several hearings on the plans to abolish grade crossings of the Boston & Maine in this town. The grade crossings on the Boston, Revere Beach & Lynn RR. will also be considered.

ROCHESTER, N. Y.—Conferences have been held between the city and officers of the New York Central RR. regarding the proposed new crossing at Saxton St. A subway is suggested.

ROSWELL, GA.—Contracts will be let at public cry, June 30, for a bridge across the Chattahoochee River, between Fulton and Cobb counties at Roswell. The bridge (probably wood) is to be 592 ft. long, of six spans, from 78 ft. to 124 ft. long. E. B. Rosser, Chairman Commissioners Roads and Revenues Fulton County, Atlanta. J. M. Stone, Ordinary Cobb County, Ga.

ROUSE'S POINT, N. Y.—An arrangement has been made between the Central Vermont and the Rutland railroads whereby the bridge over the upper end of Lake Champlain from Alburgh, Vt., to this place will be used jointly by the two roads. The bridge proposed by the Rutland will not be built.

SALEM, N. J.—Bids have been asked for a bridge in this town.

SAN ANTONIO, TEX.—The loss sustained by Bexar County for a bridge destroyed over the Salado Creek on the Goliad Road, nine miles from this place, is estimated at $20,000.

SCARSDALE, N. Y.—A bridge over the New York & Harlem tracks, north of the Scarsdale station, burned May 14, will be replaced by a steel bridge.

SEATTLE, WASH.—The county highway bridge over the Snoqualmie River at Falls City recently collapsed. It was 270 ft. long, 16 ft. wide and cost $12,000.

SNOHOMISH, WASH.—The Great Northern will build a steel bridge over the Snohomish River at this place during the summer.

SPARTA, TENN.—Plans prepared by the Indiana Bridge Co. are reported accepted for a steel bridge at Taylor's Mill. It is also stated that bids for building are wanted.

STERLING, COL.—The Burlington & Missouri River bridge over the South Platte River at Sterling was partly destroyed May 2, by a wooden bridge washed out by a flood.

THERMOPOLIS, WYO.—A steel bridge about 350 ft. long will be built over a stream at Thermopolis by the direction of the State Board of Charities and Reform. F. B. Sheldon is Clerk, Cheyenne, Wyo. (April 12, p. 243.)

TOWANDA, PA.—A resolution is before the Town Board to petition the County Court to build the proposed bridge over the Susquehanna River.

WASHINGTON, D. C.—An amendment to the Sundry Civil Bill appropriates $200,000 for the Secretary of War to begin work on the Memorial bridge.

ZANESVILLE, O.—Plans and specifications are on file in the County Commisioners' office and with the Osborn Co., Cleveland, for the new Y bridge over the Muskingum River, for which contracts will be let June 14. The total length of the bridge will be about 900 ft.

Other Structures.

ASHTABULA, O.—The Pennsylvania Co. is about to begin work on a new engine house at Ashtabula.

BUFFALO, N. Y.—The New York Car Wheel Works at Black Rock will be enlarged. The capital of the company was recently increased.

DECATUR, ILL.—The F. W. Menke Stone & Lime Co., of Quincy, began work May 1 on a new passenger station and division office building for the Wabash RR. in Decatur. It will be two stories high, 46 ft. wide and 230 ft. long. It will be built of brick, with terra cotta trimmings and cost $50,000.

GALION, O.—The Big Four will build a $20,000 station in this city. It will be 124 ft. x 52 ft.

GLENDIVE, MONT.—The Northern Pacific freight depot was recently totally destroyed by fire.

GRAND RAPIDS, MICH.—The Michigan Central freight depot at South Ionia St. was destroyed by fire May 7, including a number of freight cars.

JERSEY CITY, N. J.—The Pennsylvania has under consideration a large pier in the Upper Bay of New York Harbor at Greenville. Application has been made to the Government for permission to build the pier 4,400 ft. beyond the bulkhead line.

MONTREAL, QUE.—The application of the Canada Atlantic RR. for a site on one of the wharves for a 2,000,000 bushel elevator and warehouse was before the Harbor Commissioners May 8. The structure is estimated to cost $500,000.

PARKERSBURG, W. VA.—The Williams Steel Co. has been incorporated to make and deal in iron and steel. The capital is $750,000. The incorporators are: R. B. Scandrett, T. C. Noble, both of Allegheny, Pa.; H. J. Williams, S. G. Smith, both of Carnegie, Pa.; S. G. Smith of Wheeling, W. Va. S. G. Smith, attorney, Wheeling.

PETERSBURG, VA.—The City Council has granted the Seaboard Air Line permission to build two passenger stations in Petersburg, one on Market St. for local passenger service, and one on Dunlop St. for through trains.

PITTSBURGH, PA.—The Pennsylvania has contracted with Andy Brann, of Philadelphia, for a temporary passenger station to be built east of the present depot. F. T. Dumont, Assistant Construction Engineer of the Pennsylvania in charge of the union depot work, received bids on May 12 for the iron in the south span of the present train shed at the union depot. The shed is 300 ft. long and must be removed to permit of building the temporary passenger station.

SALT LAKE CITY, UTAH.—The Rio Grande Western has in contemplation an addition to its shops. A ten-stall round-house will be built.

SCHENECTADY, N. Y.—See New York Central in Railroad Construction Column.

SIOUX CITY, IA.—Plans have been made for an extension to the freight house of the Chicago, St. Paul, Minneapolis & Omaha at Sioux City. The extension will be of brick, 150 ft. long.

TOPEKA, KAN.—The Atchison, Topeka & Santa Fe contemplates extensions to its shops at Topeka.

UTICA, N. Y.—The Delaware, Lackawanna & Western, we are informed, will build a freight house at Utica about 30 x 200 ft. The building will be one story high and of brick. No contracts have yet been let.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xi.)

American Ticket Brokers' Association.

The American Ticket Brokers' Association at the annual meeting in Detroit, Mich., May 11, elected the following officers: President, Simon Steiner, of St. Louis, Mo.; Secretary, W. B. Carter, Louisville, Ky. The next meeting will be held in Kansas City, Mo.

The Traveling Engineers' Association.

The Traveling Engineers' Association has lately sent out two circular letters asking for information. One of these is from the Committee on packing boxes and lubrication of bearings, the Chairman of which is Mr. B. Meadows, Box 578, St. Thomas, Ont. This committee wants information as to the methods used in packing boxes on engines and the kind of lubricant used and the results attained.

Another committee seeks information on the use of the steam indicator as an aid to the traveling engineer in determining the efficiency of a locomotive. The Chairman of this committee is Mr. G. W. Wildin, Motive Power Department, Plant System, Savannah, Ga.

Franklin Institute.

The following is the program of the stated meeting of the Institute for May 16:

Recent Improvements in Making Liquid Air; the Separation of Air into its Constituent Parts, and the Industrial Use of Oxygen, Nitrogen and Carbon Dioxide, by Prof. Raoul Pictet and Mr. Moriz Burger. This communication includes description of a novel apparatus for liquefying air, which exhibits substantial improvements, and an ingenious method of separating the constituent elements of the air, devised by Prof. Pictet, and which promises to find important applications in the industrial arts, especially in metallurgy.

Western Railway Club.

At the annual meeting of the Western Railway Club, held Tuesday of this week, the following officers were elected: President, A. E. Manchester, Assistant Superintendent of Motive Power, Chicago, Milwaukee & St. Paul; First Vice-President, Prof. William F. M. Goss, Purdue University; Second Vice-President, J. F. Deems, Assistant Superintendent of Motive Power, Chicago, Burlington & Quincy; Treasurer, P. H. Peck, Master Mechanic, Chicago & Western Indiana; Directors, R. D. Smith, Division Master Mechanic, Chicago, Burlington & Quincy; George R. Henderson, Mechanical Engineer, Chicago & Northwestern; F. W. Sargent, Sargent Co.; Trustees of the Library, F. W. Sargent, Chairman; William Forsyth and F. A. Delano, Superintendent of Motive Power, Chicago, Burlington & Quincy.

The Engineers' Club of Philadelphia.

At the regular meeting of the Club to be held on Saturday, May 19, the paper of the evening will be "The Bacterial Treatment of Sewage in England," Illustrated. By Prof. William Easby.

Modern Methods of Making Illuminating Gas.

Mr. Frederick H. Shelton, at the meeting on May 5, presented a communication upon the above subject, and illustrated his descriptions by blackboard sketches. He explained the modern methods of making coal-gas and water-gas on a large scale, and a method which he has lately applied of distributing the gas at a higher pressure than usual (about 20 lbs. instead of ½ lb.) in order to save original expense by reducing the size of the mains. For several months past gas has been distributed five miles from Phoenixville, Pa., in accordance with this system, and with complete success.

The general subject of gas production and distribution was discussed by Messrs. Fred. W. Gordon, W. Forstall, Edgar Marburg, L. Y. Schermerhorn and James Christie.

Toothed Gearing.

The three communications on toothed gearing, which were announced for the meeting of May 5 were postponed.

The British Iron and Steel Institute.

Some of the papers read at the annual meeting of the Iron and Steel Institute of Great Britain, May 9 and 10, at the Institution of Civil Engineers, Great George St., Westminster, London, were the following: "Ingots for Gun Tubes and Propeller Shafts," by F. J. R. Carrulla of Derby; "The Manufacture and Application of Water Gas," by Carl Dellwik of Stockholm; "The Equalization of the Temperature of Hot Blast," by Lawrence Gjers and Joseph H. Harrison of Middlesbrough; "Blowing Engines Driven by Crude Blast Furnace Gas," by Adolphe Greiner of Seraing, Belgium; "The Solution Theory of Iron," by Baron H. von Juptner of Donawitz, Austria; "The Use of Fluid Metal in the Open Hearth Furnace," by James Riley of Stockton-on-Tees; "The Manganese Ores of Brazil," by H. Kilburn Scott of Minas, Brazil; "The Utilization of Blast-Furnace Slag," by Ritter Cecil von Schwarz of Liege; "Iron and Phosphorus," by J. E. Stead of Middlesbrough; "The Continuous Working of the Open Hearth Furnace," by Benjamin Talbot of Pencoyd, Pa.

Among the Americans who will be voted on for admission as members at this meeting are Albert Ladd Colby of South Bethlehem, Pa.; Edmund E. Johnston of Ashland, Wis.; John Stuart Kennedy of Stanhope, N. J.; Simon S. Martin of Sparrow's Point, Md.; P. C. Patterson of the National Tube Company, McKeesport, Pa., and H. F. J. Porter of South Bethlehem, Pa.

American Society of Civil Engineers Convention of 1900.

The thirty-second annual convention of the Society will be held, in response to the cordial invitation of the Institution of Civil Engineers, at the House of that Institution, Great George St., Westminster, S. W., London, during the first week in July, 1900. The Committee of the Board of Direction is: Palmer C. Ricketts, H. S. Haines, Henry Manley, Rudolph Hering, Charles Warren Hunt. The Local Committee of Arrangements is: Sir Benjamin Baker, Sir Douglas Fox, Rawlinson T. Bayliss, James R. Bell, William Henry Booth, George Earl Church, A. G. Glasgow, Robert Gordon. Alfred Francis Harley, John A. McDonald, Hiram S. Maxim, William B. Myers-Beswick, John P. O'Donnell, M. E. Yeatman, Albert J. Campbell, Millard Hunsiker, J. R. Furman, Victor M. Clement. The subjects for informal discussion are:

Height of Buildings.—What considerations should limit the height of buildings? Do recent developments in construction, sanitation, intercommunication and economy of administration, warrant the removal of all restrictions?

Recent Practice in Rails.—The progressive increase in weight; the increase in hardness, particularly in carbon; the sections in most general use; the effect of changes in weight, composition and section.

Filtration of Water for Public Use.—The several processes now used for the removal of objectionable matter; their comparative sanitary effect, cost and reliability.

The opening session of the Convention will be held during the afternoon of Monday, July 2, 1900, when the Society will be welcomed by the President of the Institution, Sir Douglas Fox; and John F. Wallace, President, Am. Soc. C. E., will deliver the annual address.

On Monday evening the first of the topical discussions, relating to high buildings, will be opened by Corydon T. Purdy, M. Am. Soc. C. E., who will illustrate his remarks with stereopticon views. Other meetings will be arranged for the discussion of the other subjects, and a time will be set for a business meeting. The dates and other particulars of these meetings, as well as excursions to points of interest, etc., will be arranged by the Local Committee. Members who are unable to attend are invited to send written communications on any of the subjects, for presentation at the meeting.

On the evening of Thursday, July 5, 1900, the Institution will hold its annual conversazione in the ancient Guildhall of the City of London, and has invited the members of the Society, as well as the ladies of their families, to this ceremony. Members of the Institution, and all American engineers, whether connected with this Society or not, will be invited to attend the meetings and take part in the discussions.

The latest returns indicate that 53 members of the Society, from America, accompanied by 49 members of their families, making a total of 102, will attend the Convention. In addition to this, a number of foreign members will be in attendance.

PERSONAL.

(For other personal mention see Elections and Appointments.)

—Mr. E. C. Wright, for several years Secretary and Assistant Comptroller of the Southern Pacific, has been appointed Treasurer of the Pacific Improvement Company.

—Mr. A. W. Foster, President of the California Northwestern Ry., has been appointed Regent of the University of California, succeeding Mr. A. S. Hallidie, deceased.

—Mr. Coleman F. Leaming, a Director of the West Jersey & Seashore, died at his home in Cape May Court House, N. J., May 13. He was born at Dennisville, N. J., in 1818.

—Mr. James Sloan, Jr., a Director of the Baltimore & Ohio Southwestern, died May 13, aged 67 years. Mr. Sloan was identified with a number of business and financial enterprises.

—Mr. S. B. Hynes, who recently resigned as General Manager of the Los Angeles Terminal Ry., has been appointed Secretary of the Safety Car Heating & Lighting Co., with headquarters at Chicago, Ill.

—Mr. C. H. Nimson, recently General Superintendent of the East Tennessee & Western North Carolina, has retired from railroad business altogether and will devote his time to cattle and sheep breeding, in which he has been interested for 45 years.

—Mr. John Reed, of the draughting department of the Rhode Island Locomotive Works, has been appointed Machine Shop Foreman of the Delaware, Lackawanna & Western, at Scranton, Pa. Mr. Reed served his time in the Rhode Island Locomotive Works, as machinist and draughtsman. He then began railroad work on the Maine Central and was General Foreman at Waterville, Me., for four years. He went from there to the draughting department of the Pittsburgh Locomotive Works and back again to the draughting department of the Rhode Island Locomotive Works.

—Mr. H. W. McMaster, Superintendent of the Toledo Division of the Wheeling & Lake Erie, was born in 1860. He began railroad work as a telegraph operator on the Detroit, Lansing & Northern in 1872, and was employed as operator and agent by that company until 1878. For three years following he was operator and Dispatcher with the Grand Rapids & Indiana, and then for two years Dispatcher with the Chicago & Northwestern. From 1883 to 1888 he was Dispatcher and Trainmaster with the Union Pacific. Since 1888 he has been with the Northern Pacific as Chief Dispatcher and Trainmaster.

—Mr. Chas. H. Moore, First Assistant Engineer of the Erie, was born Dec. 9, 1863. He was graduated at Lafayette College in the class of 1884. For the four years following he was engaged in mill construction and in the installation of heavy machinery. He entered service with the New York, Lake Erie & Western in 1888 as rodman. Two years following he was appointed Resident Engineer of the Northern of New Jersey. In 1891 he was made Assistant Engineer of the New York, Lake Erie & Western, and then after two years he received a similar position with the Quaker City & New England Construction Co. of Philadelphia. Since 1894 he has been with the Erie as Assistant Engineer and now as First Assistant Engineer.

—Mr. James E. Lawton on May 1 became Superintendent of the East Tennessee & Western North Carolina, with headquarters at Cranberry, N. C. Mr. Lawton's experience in railroading has been in building and operating short mineral roads. He was born in Barlow, Washington County, O., June 21, 1850. After obtaining a high school education at Ironton, O., he was employed as a civil engineer until 1873, and since that time has been for the most part superintendent of various mines. From July, 1899, until his recent change he was superintendent of mines for the Division Empire Steel & Iron Co. of New York,

at Greensboro, N. C. In addition to his duties as Superintendent of the East Tennessee & Western North Carolina, he is General Manager of the Cranberry Iron & Coal Co.

—As already noted, Mr. Maurice A. Zook becomes the Chief Engineer of the Louisville, Evansville & St. Louis. Mr. Zook is a member of the American Society of Civil Engineers and was graduated from the Pennsylvania Polytechnic College. He is a native of Philadelphia. He was three years with the Shenandoah Valley and the Norfolk & Western railroads as Assistant Engineer and Resident Engineer in charge of heavy construction. For 5½ years he was on the Pennsylvania Company's lines as Assistant Engineer, Engineer in charge of the Indianapolis Union Ry., Engineer of Maintenance of Way of the Indianapolis & Vincennes, and Engineer of Maintenance of Way of the Chicago Division of the Pittsburgh, Cincinnati, Chicago & St. Louis. For two years he was on the Louisville, New Albany & Chicago (now Chicago, Indianapolis & Louisville), as Engineer of Maintenance of Way, and later as Superintendent of the Chicago Division. He spent five years with the Alabama Great Southern line of the Queen & Crescent Route as Roadmaster and Engineer of Maintenance of Way. He has been with his present company, the Louisville, Evansville & St. Louis, for the past two years as Assistant Engineer in charge of Maintenance and Construction, as Engineer of Maintenance of Way, and then as acting Chief Engineer.

—We have already published some of the resolutions adopted by boards of directors concerning the late C. H. Coster. Those which were adopted by the Board of Directors of the Chesapeake & Ohio Ry. follow: "In the death of the late Charles Henry Coster this Board has suffered a very serious loss—a loss that is almost irreparable for those of us who for so many years have found in him a colleague and adviser, gifted with unusual sagacity, quickness of apprehension, and ability of execution.

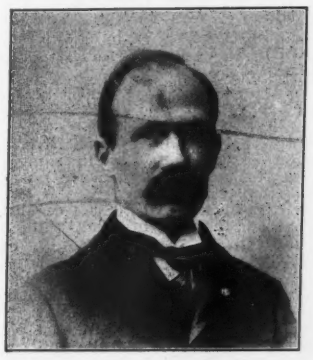
"As a member of our Executive Committee for twelve consecutive years, he has shown a marvelous grasp of the many improvements and changes which from time to time have become necessary, and we feel that it is in a great measure due to his unequaled ability and untiring energy that this company now occupies its present high position among the railroads of this country.

"Though always careful and conservative, he was, when the occasion demanded, courageous and farsighted to a remarkable degree.

"As a friend he inspired confidence and esteem, and it is as a friend as well as a colleague that we deeply mourn the loss that we have suffered by his death.

"It is hereby resolved that this expression of our feelings be duly entered upon the minutes of this meeting, and that the President of the company be instructed to have a copy of the same suitably engrossed and forwarded with our deepest sympathy to the members of his family."

—We have already recorded the appointment of Mr. C. M. Mendenhall as Superintendent of Motive Power of the Chicago & Alton. Mr. Mendenhall was born Sept. 2, 1859, at Ft. Monroe, Va., his father being an officer of the army. In July, 1882, he entered the Pennsylvania shops at Altoona as an apprentice and remained at Altoona, working through the various departments, including the test department, until April, 1889, when he was made Assistant Road Foreman of Engines on the New York Division. In December, 1890, he became Assistant Master Mechanic of the Meadows shops, and in April, 1894, he was made Assistant Engineer of Motive Power of the United Railroads of New Jersey Division. June 17, 1895, he became Superintendent of Motive Power of the Philadelphia, Wilmington & Baltimore, which position he has held until his appointment to the Alton. Mr. Mendenhall has been active in the associations and the New York Railroad Club, of which later organization he is now First Vice-President.



ELECTIONS AND APPOINTMENTS.

Chicago, Milwaukee & St. Paul.—C. W. Whiting has been appointed Mechanical Engineer.

Choctaw, Oklahoma & Gulf.—C. W. Welch has been appointed Master Mechanic, with headquarters at Little Rock, Ark., succeeding C. Robken, resigned.

Cleveland, Cincinnati, Chicago & St. Louis.—J. A. Hanson has been appointed Supervisor of Bridges and Buildings of the Cairo Division, with headquarters at Mt. Carmel, Ill., succeeding J. Forbeck, transferred.

Delaware Valley & Kingston.—George T. Slade has been appointed General Manager, and Sidney Williams Comptroller, both with headquarters at Dunmore, Pa., effective May 9.

El Paso & Northeastern.—J. A. Eddy, General Manager at Alamogordo, N. M., has resigned.

Florida Central & Peninsular (Seaboard Air Line).—The jurisdiction of W. T. Reed, Mechanical Superintendent, and of G. P. Johnson, Superintendent of Transportation, of the Seaboard Air Line, with headquarters at Portsmouth, Va., has been extended over all Divisions of the F. C. & P., effective May 10.

Great Northern (Canada).—At a meeting of the stockholders J. McNaught was elected Second Vice-President; H. H. Melville, Third Vice-President and E. E. Ling, Treasurer.

Hocking Valley.—The following new Directors have been elected: Robert Bacon, Ralph W. Hickox, Thomas Johnson, R. S. Warner and Charles Steele. Mr. Steele succeeds Mr. Coster, deceased.

Kansas City & Southern.—John Lambert was, on May 5, elected Chairman of the Board, succeeding William Edenborn, who resigned and became First Vice-President. The Executive Committee is composed of E. H. Harriman, Otto H. Kahn, John W. Gates, John Lambert and William Edenborn.

Lake Erie & Detroit River.—W. Wollatt, heretofore General Superintendent and Traffic Manager, has been appointed General Manager.

Lake Shore & Michigan Southern.—A. A. Bradeen having resigned as Master Mechanic of the Eastern and Franklin Divisions, the jurisdiction of S. K. Dickerson has been extended to include these Divisions, with headquarters at Cleveland, O. E. T. Grahn has been appointed Assistant Master Mechanic, with headquarters at Norwalk, O.

Long Island.—Henry L. DesAnges has been appointed Superintendent of Floating Equipment, with headquarters at Long Island City, N. Y.

Louisville & Nashville.—John Marston, Jr., has been appointed Chief Engineer of the Construction of New Lines in Alabama, and J. E. Willoughby Principal Assistant Chief Engineer of Construction of New Lines in Alabama. Their headquarters being in the Commercial Club Building, Birmingham, Ala.

Manitoba & Northwestern.—W. R. Baker, General Manager at Winnipeg, Man., has resigned. (See Railroad News column.)

Ohio Southern.—John Dixey has been appointed Master Car Builder, with headquarters at Springfield, Ohio.

Pennsylvania.—Richard N. Durborow, Master Mechanic at the West Philadelphia shops at W. Philadelphia, Pa., has resigned to go to the Philadelphia, Wilmington & Baltimore.

Philadelphia, Wilmington & Baltimore (Pennsylvania).—Richard N. Durborow, heretofore Master Mechanic of the Pennsylvania, has been appointed Superintendent of Motive Power of the P., W. & B., succeeding C. M. Mendenhall, resigned, effective May 15.

St. Joseph & Grand Island.—Raymond DuPuy, heretofore Division Superintendent of the Delaware, Lackawanna & Western, has been appointed General Manager of the St. J. & G. I., with headquarters at St. Joseph, Mo., succeeding W. P. Robinson, Jr., resigned.

St. Louis & San Francisco.—Press reports say that D. B. Robinson, President, has resigned on account of ill health.

St. Paul & Duluth (Northern Pacific).—A. B. Plough, Vice-President and General Manager, has resigned. Daniel S. Lamont has been elected Vice-President and J. W. Kendrick, Second Vice-President of the N. P., will assume the duties of General Manager of the St. P. & D.

Santa Fe Pacific.—W. S. Hancock, Division Master Mechanic at Winslow, Ariz., has resigned.

Southern Pacific.—G. T. Klink, heretofore Auditor of Disbursements, has been appointed General Auditor. E. C. Wright, Secretary, has resigned.

Texarkana & Fort Smith (K. C., P. & G.).—C. E. Swindell has been appointed General Passenger Agent, succeeding W. W. Avery.

Wheeling & Lake Erie.—At a meeting of the stockholders the following Directors were elected: Myron T. Herrick, George A. Garretson, H. P. McIntosh, W. G. Mather, F. G. Hearne, C. M. Spitzen, George Coppell and Washington E. Connor.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALABAMA BLACK BAND IRON, COAL & RAILROAD CO.—The Noel-Young Bond & Stock Co., of St. Louis, has issued a prospectus of this proposed line in Alabama from a point on the Memphis & Charleston, near Paint Rock, Ala., extending northward up Paint Rock River Valley through coal, iron and timber lands. The company is chartered for $800,000 and owns about 30,000 acres of land. It is proposed to issue first mortgage 5 per cent. 20-year bonds at the rate of $10,000 per mile of line, and $4 per acre of land, and to sell not to exceed $240,000 of these bonds at par, with a bonus of an equal amount of capital stock. It is proposed to build 12 miles of the road which is already partially graded. (Alabama Roads, April —, p. 263.)

AMERICAN RAILWAY CO. OF NEW YORK.—This company was incorporated at Charlestown, W. Va., May 8, with a capital stock of $5,000,000, to build, operate and lease railroads. Among the incorporators are: Osborn Congleton, Lina Beecher, T. P. Daniels, H. V. Brandenburg and Miers J. Darby, all of New York.

ATCHISON, TOPEKA & SANTA FE.—Surveys are reported in progress for an extension from Moline, Kan., southwest about 90 miles via Cedarvale to Stillwater, O. T.

BALTIMORE & OHIO.—Building is under consideration, according to report, for a cut-off from Washington, Pa., east about 45 miles, via Coal Center, to connect with the Pittsburgh & Connellsville Division, 1½ miles south of Connellsville. The surveys and some grading were done several years ago. The line would shorten the distance betwen Washington and Connellsville by about 40 miles. The present route is via Glenwood.

Preliminary surveys are reported in progress for a tunnel on a cut-off at Union Dam, Md., on the main line, two miles west of Ellicott City.

An officer writes that there is no truth in the report that the company will extend its Savage Branch from Savage, Md., north to Guilford. (May 11, p. 311.)

BRANDON & SOUTHWESTERN.—The Dominion Senate has passed the bill granting a charter to this company to build from Brandon, Man., northeast to Gladstone; thence southeast to Carmine, and south to the international boundary line in range 5 or 6. The company is supposed to be backed by the Canadian Pacific. J. E. Evans, of Winnipeg, Man., is Chief Engineer. (Nov. 17, 1899, p. 800.)

BUFFALO & SUSQUEHANNA.—An officer writes that the company has at present no plans for extending the line beyond Sinnemahoning, Pa., to connect with the Pennsylvania. The extension is being built from Bailey Run southwest. (May 4, p. 295.)

CANADA NATIONAL RAILWAY & TRANSPORT.—The bill incorporating this company has passed the Dominion Legislature. The road projected is an air line from Toronto, Ont., northwest about 100 miles to Collingwood, on the Georgian Bay. It is proposed to make the line a land link in a grain route between Duluth and the European markets. The directors are John Wilson, Fred. T. Hodgson and D. Wilson, all of Collingwood, Ont.

CENTRAL OF NEW JERSEY.—An officer writes that the company is about to reclaim a portion of Communipaw Flats at Jersey City and is building a temporary bulkhead back of the permanent bulkhead line. As soon as this temporary bulkhead is completed the fill will be commenced and graded to proper level as rapidly as the material can be placed.

CHATHAM & LEBANON VALLEY.—The Vermont end of this road, formerly the Lebanon Springs, is being put in repair for running trains about June 1.

CHERRY VALLEY.—This company was incorporated in West Virginia May 12, with a capital stock of $10,000, to build a railroad from Richwood southeast about 15 miles to Locust. The incorporators are: J. W. Oakford, C. D. Simpson, Henry Belin, Jr., S. L. Peck, C. P. Davidson, all of Lackawanna, Pa.; Attorneys, Campbell, Holt & Campbell, Huntington, W. Va.

CHICAGO & NORTHWESTERN.—An officer writes that it is not the intention, at present, of the company to make the extensions referred to last week (p. 311), namely, from Kingsley, Ia., northwest to Hawarden, and from Perkins, Mich., into timber belt along White Fish River.

CHICAGO, BURLINGTON & QUINCY.—New yards to contain about 16 miles of track will be built at Albert Lea, Minn., according to report, involving an expenditure of $100,000.

Work is begun on an improvement of the line from Burlington, Ia., to Oskaloosa, which is to be changed to standard gage, and probably extended from Oskaloosa to some point on the Albia Branch, giving a direct route from Burlington to Des Moines. The grade is being much improved and several new bridges built.

The residents of Gilmanton, Wis., are agitating for a branch from Alma northeast about 20 miles to that city.

CHIHUAHUA & PACIFIC.—The Government has granted a concession for a further extension of 250 km. (155 miles). The company is building from Chihuahua, Mex., west ... miles to Guerrero. (Dec. 8, 1899, p. 853.)

CHOCTAW, OKLAHOMA & GULF.—Arrangements are reported being made to build about six miles of line to connect this road with coal mines near Fort Smith, Ark.

DELAWARE VALLEY & KINGSTON.—The New York, Ontario & Western last week applied to the Appellate Division of the Supreme Court of New York for a writ of certiorari in view of the action of the State Railroad Commission in authorizing the building of this independent coal road. The writ, together with a stay of all proceedings, was granted. It is stated that the case, if necessary, will be carried to the Court of Appeals, and that these legal proceedings will delay all building for at least a year. (May 11, p. 311.)

DENVER & RIO GRANDE.—Surveys are reported in progress for an extension from Durango, Col., southwest to the Grand Canyon in Arizona.

DULUTH & NEW ORLEANS.—Grading was begun last week on the line between Des Moines and Osage, Ia., in the vicinity of Cambridge. J. M. Hawthorn of Newton, Ia., has the contract. The company expects to have this section graded within the next three months. S. V. Wardall of Ames, Ia., is President. The central office is Nevada, Ia. (March 9, p. 161.)

FITCHBURG.—The company is enlarging its freight yard north of Lincoln Square at Worcester, Mass.

HILGARD, GRANITE & SOUTHWESTERN.—Chief Engineer W. T. Chalk, from preliminary surveys made, reports the feasibility of this proposed line from Hilgard, Ore., on the line of the Oregon Railroad & Navigation, to run south 60 miles through Granite. J. M. Church, Cashier of the La Grande (Ore.), National Bank, is an incorporator. The central office is La Grande. (Jan. 26, p. 64.)

IDAHO MIDLAND.—Grading is reported begun on this line from Boise, Id., northeast about 300 miles to Butte, Mont. Thomas W. Bates, of Boise, is President. (Feb. 16, p. 112.)

ILLINOIS CENTRAL.—The company has decided to build, according to report, its proposed extension from Parsons, Miss., east 17 miles to Grenada. (Aug. 18, 1899, p. 589.)

INTEROCEANIC OF MEXICO.—Press reports from the city of Mexico state that an extension will be built from Tlancualpican south about 75 miles to Tlapa in the State of Guerrero.

MASSENA TERMINAL.—This company whose incorporation was noted last week, has already built its road. It is a terminal road at Massena Springs, N. Y., running north across the Racquette and Grasse rivers to the power house of the St. Lawrence Power Co., on the north side of Grasse River. No rolling stock is provided for the present and the company does simply switching business. (May 11, p. 311.) Wm. F. Zimmermann, 40 Wall St., New York, is President, and Chas. R. Hebard, Secretary. (Official.)

MEXICAN CENTRAL.—See Railroad News column.

MISSOURI PACIFIC.—An officer writes that up to the present time no decision has been reached with reference to the building of the line between Cornell, Kan., and Webb City, Mo. (May 11, p. 312.)

MORRIS & PORTAGE.—The Dominion Senate has passed the bill granting a charter to this company from Morris, Man., on the C. P. R., to run northwest about 60 miles to Portage la Prairie. Thomas L. Metcalfe, of Winnipeg, was the solicitor. (Jan. 12, p. 30.)

NEW YORK CENTRAL & HUDSON RIVER.—Plans have been prepared for extensive improvements at Cohoes, N. Y., including the elimination of grade crossings and building new passenger and freight stations and additional tracks. About $1,000,000 is to be expended for eliminating grade crossings, building freight stations, etc., in Schenectady, N. Y.

NEW YORK, NEW HAVEN & HARTFORD.—The directors on May 12 authorized the double tracking of the Naugatuck Division to Waterbury, Conn. (March 9, p. 161.)

NORFOLK & LYNN HAVEN.—This company has been incorporated to build a railroad from Norfolk, Va., to a point near Lynn Haven Bay. Col. Wm. Lamb, of Norfolk, Va., is among those interested. The company has not yet been organized.

NORTHERN PACIFIC.—Right of way is reported completed for the entire distance from Riverside, Wash., northeast 32 miles to Covello. (April 13, p. 246.)

PENNSYLVANIA.—C. A. Sims is reported to have received the contract for the extension from Mt. Etna, Pa., to run east about nine miles to Petersburg, on the main line. (May 11, p. 312.)

Surveys are reported in progress for a cut-off from Turtle Creek and Murrysville, Pa., to run north about 15 miles to New Kensington.

Work is reported begun on the extension from Crabtree, Pa., north about four miles to New Alexandria. (March 23, p. 194.)

PERE MARQUETTE.—Michigan press reports state that the main line is to be improved, including reballasting from New Buffalo, Mich., to Petoskey; from Ludington to Toledo, and from Grand Rapids to Detroit. About 75 miles of new ballast is to be put in this year, and 30 miles of new 70-lb. rails laid.

PETERSBURG & CLAREMONT TERMINAL.—Preliminary surveys are reported in progress for this line from a point near Petersburg, Va., to run east 25 miles to Claremont. Geo. T. Seay of Petersburg, and J. R. Hopper, Claremont, are among the incorporators. (March 2, p. 146.)

QUEBEC & LAKE HURON.—The bill incorporating this company has become a law. The line, as projected, is from Quebec west about 440 miles, via St. Alban and Mattawa to the mouth of the French River on the Georgian Bay. The capital stock is $10,000,000, and the company is granted the privilege of bonding to the extent of $30,000 per mile. It is to be chiefly a freight line to take grain from the West direct to Quebec. The Canadian Government is to spend a large sum on harbor improvements at the French River. Among the directors are: Chas. L. Langelier, of Quebec; John M. Nicol, 311 Hammond Bldg., Detroit, and J. D. Hawks, President and General Manager of the Detroit & Mackinac Ry., Detroit. (Feb. 23, p. 128.)

READING, LANCASTER & BALTIMORE.—Grading is to be begun soon, according to report, on this line from Reading, Pa., south about 70 miles to New Holland, and thence to a point in Maryland to connect with a line to Perryville, at the head of Chesapeake Bay. D. R. Brewer & Co., 52 Broadway, New York, are reported interested. (May 5, 1899, p. 324.)

SOUTH CAROLINA ROADS.—The Winnsboro Granite Co. is grading an extension of six or seven miles beyond the Winnsboro quarry to the Anderson quarry. The road now runs from Rockton, three miles below Winnsboro, to the Winnsboro quarry, five miles. It is a private line operated by the Southern. The Granite Co. recently issued $100,000 bonds to build the extension, increase its plant, etc. J. E. McDonald, of Winnsboro, S. C., is Attorney for the company at that city. A. W. St. Amand, of Rion or Winnsboro, is Manager. (Official.)

SOUTHERN PACIFIC.—Extensive additions to freight facilities are proposed at Ashland, Ore.

TENNESSEE & NORTH CAROLINA.—M. P. Walker and others have been appointed by the Board of Trade of Waynesville, N. C., to obtain right of way for this line from Newport, Tenn., southeast about 40 miles to Waynesville. (March 9, p. 162.)

TENNESSEE ROADS.—The Cleveland Construction Co., of Cleveland, O., is promoting a railroad from Sparta, Tenn., on the Nashville, Chattanooga & St. Louis, to run northeast about 100 miles via Algood and Livingstone, Tenn., and Albany and Monticello, Ky., to Burnside, on the Cincinnati, New Orleans & Texas Pacific. Surveys are in progress and building is to be begun at Sparta and Algood within 30 days. There will be a number of trestles, two tunnels and three bridges. R. L. Palmer, of Cleveland, O., is President. E. Bortram, of Albany, Ky., is interested. (Official.)

TORONTO & GEORGIAN BAY.—George Watson on May 2 introduced a bill into the Dominion Parliament to incorporate this company to build a railroad on a route similar to that of the Canada National Railway & Transport. (See above.) Among those interested are: J. W. Flavelle, A. E. Ames, W. E. H. Massey, A. E. Kemp and Robert Kilgour, all of Toronto.

TORONTO, LINDSAY & PEMBROKE.—The proposed route of this line is from Golden Lake, Ont., to run southwest through the townships of Algoma, Faraday, etc., connecting with the Irondale, Bancroft & Ottawa and the Central Ontario at Bancroft. Preliminary surveys are made and building is likely to be begun this season. (May 4, p. 296.) Among the directors are R. W. Gordon, J. G. Forgie and W. H. S. McCallum, of Pembroke, Ont. (Official.)

UNION PACIFIC.—Owen Bros., of Norfolk, Neb., are reported to have taken the contract for a large number of side tracks between Omaha and Ogden, approximating 70 miles. (May 4, p. 296.)

The company, according to report, will begin at once to build a spur from Rawlings, Wyo., to iron mines and stone quarries near that place.

VANCOUVER & LULU ISLAND.—Grading is reported begun on this line from Fairfield, B. C., to the north arm of the Fraser River. McDonald & Morrison, of New Westminster, and McQuarrie & Co. have the contracts for six miles. H. Abbott, of Vancouver, B. C., is a director. (Feb. 2, p. 80.)

VIRGINIA ROADS.—An officer of the Dump Creek Railroad & Mining Co. writes that the company has bought and expects to develop coal lands in Russell and Dickenson counties, Va., and expects to build a connecting line of eight miles to the Norfolk & Western. J. Yost of Staunton, Va., is President, and E. Cooper Shapley, Stephen Girard Bldg., Philadelphia, Vice-President. (May 11, p. 312.)

WESTERN ALBERTA.—The Dominion Senate has passed a bill granting a charter to this road. It was asked for by Messrs. Longbreed & Bennet. (Jan. 19, p. 48.)

WINNSBORO & CAMDEN.—Application was made in South Carolina May 7 for a charter for this company with a capital stock of $300,000, to build its proposed line from Camden, S. C., on the Seaboard Air Line, west 30 miles via Ridgeway to Winnsboro, on the Southern. Subscription books will be opened about June 21. The incorporators are Thomas K. Elliott, W. R. Elliott, Thomas H. Ketchin and J. E. McDonald, all of Winnsboro. (May 4, p. 296.)

GENERAL RAILROAD NEWS.

ARKANSAS, LOUISIANA & SOUTHERN.—An officer of the Louisiana & Arkansas confirms the statement that his company has bought the A., L. & S., but before the transfer can be made it is necessary to publish the sale for 60 days. At that time there will be a meeting of the stockholders to ratify the sale. (April 27, p. 280.)

BELLINGHAM BAY & BRITISH COLUMBIA.—Press dispatches from New Whatcom, Wash., report that an agreement has been made between this company and the Canadian Pacific whereby the trains of the C. P. R. will be run into New Whatcom. The connection between the two roads is made near Sumas at the International boundary.

GREAT NORTHERN.—The company has issued a circular which states that 10,000 shares of the company's stock has been placed with a new company, to be known as the Great Northern Employes' Investment Association, Ltd. Employes whose salary is under $3,000 a year and who have been three years in continuous service with the railroad may subscribe for not more than $5,000 of this stock at par. This issue is the balance of the $100,000,000 authorized issue. (Feb. 2, p. 80.)

GREAT NORTHERN (CANADA).—Fifty-year 5 per cent. gold bonds to the amount of $6,000,000 have been authorized at the rate of $20,000 a mile. Bonds covering 179 miles from Quebec to a junction at Hawkesbury with the Canada Atlantic have been deposited with the Central Trust Co. and will be sold upon completion of the road. The authorized capital stock is $3,000,000, all common, of which $2,000,000 has been issued. A 20-year contract has been made with the Canada Atlantic for interchange of traffic on a mileage basis. The company has been granted the use of the Government docks at Quebec and all steamships run in connection with the road will be exempt from harbor, port and other dues for five years. It is expected that the line will be completed in July. (Railroad Construction, Dec. 1, 1899, p. 835.)

KANSAS MIDLAND.—The foreclosure sale is advertised to take place at Wichita, Kan., July 25, the upset price being $500,000. The St. Louis & San Francisco has arranged to take over the property. (April 20, p. 264.)

LAKE SHORE & MICHIGAN SOUTHERN.—Fisk & Robinson, of New York, are offering $2,000,000 first mortgage 3½ per cent. bonds of this company, due June, 1997, at 109¾ and accrued interest, netting 3.175 per cent. per annum. This is a part of the $8,000,000 issued to retire the first consolidated mortgage 7's maturing July 1 next. (Nov. 4, 1898, p. 806.)

LONG ISLAND.—The United States Mortgage & Trust Co., New York, notifies holders of trust certificates of stock under the agreement of Feb. 1, 1897, that an agreement has been made to sell a majority of the capital stock of the company represented by the trust certificates. Holders who desire to avail themselves of the opportunity should apply to the Trust Co. The transfer books of the voting trustees will close at 3 p. m., June 1.

LOUISVILLE, EVANSVILLE & ST. LOUIS.—The Louisville committee, representing the first mortgage 6 per cent. bonds of 1886 recently sold to Southern Ry. interests, is prepared to pay to holders of certificates of deposit representing the bonds an amount equal to the five years' overdue interest thereon ($300), less the expenses of the committee, or $285 per bond. New Southern Ry. 4s will be issued in exchange for the bonds on the completion of reorganization. Holders of Louisville Trust Co.'s receipts for second mortgage bonds of 1886 were to meet May 17 at Louisville to consider a proposition of settlement for the bonds. (April 20, p. 264.)

MANITOBA & NORTHWESTERN.—The Canadian Pacific took possession of this property on May 15. (June 23, 1899, p. 462.)

MEXICAN CENTRAL.—An additional $1,000,000 consolidated mortgage 4 per cent. gold bonds of 1911 has been listed on the New York Stock Exchange, making the total amount listed $60,643,000. The proceeds are to be used for general improvement and for building additional branch lines. (March 10, p. 182.)

MISSOURI PACIFIC.—Stockholders are to meet at St. Louis July 16 to approve the issue of $15,000,000 5 per cent. debenture gold bonds authorized by the directors April 30, and the issue of $15,000,000 stock. (May 4, p. 296.)

MONTGOMERY, HAYNEVILLE & CAMDEN.—The stockholders will meet at Camden, Ala., June 7, to consider the sale of 7½ miles of right of way, including a partially built roadbed, to the Louisville & Nashville. The company has been endeavoring for some time to build its proposed line from Montgomery southwest 102 miles via Hayneville, Farmersville and Camden to Suggsville. Eleven miles was graded in 1879. S. D. Bloch of Montgomery, Ala., is President. (Railroad Construction, May 5, 1899, p. 323.)

NEW YORK, NEW HAVEN & HARTFORD.—The General Assembly of Rhode Island on May 4 passed an act amending the charter of the company, giving it the right to condemn lands for its corporate purposes in the counties of Providence, Kent, Bristol, Newport and Washington. Persons whose land is so condemned have the right to appeal to the Supreme Court of the State.

PAWTUXET VALLEY.—The General Assembly of Rhode Island on May 4 passed an act giving this company right to issue bonds to an amount not exceeding $160,000 to replace other bonds maturing. The property is leased by the New York, New Haven & Hartford.

PENNSYLVANIA.—Reports, probably correct, are that the company has made arrangements with banks, insurance and trust companies at New York to borrow between $15,000,000 and $20,000,000 at 4 per cent. for one year, with the privilege of renewal. This money is understood to be for recent acquisition of stock in several railroad companies.

PEORIA & PEKIN TERMINAL.—E. H. Gay & Co. are offering $600,000 of first mortgage 5 per cent. sinking fund gold bonds of this company, dated Jan. 1, 1900, at 108¼. Of these bonds $550,000 are due Jan. 1, 1930, and $50,000 in varying amounts yearly from 1905 to 1929. An additional $100,000 of bonds has been authorized by the trustee for double tracking, equipment, etc., and can be issued only to an amount equal to 80 per cent. of the cost of such improvements.

PEORIA, DECATUR & EVANSVILLE.—C. C. Brown, Special Master in Chancery, made a sale of this property May 10 to satisfy second mortgage bonds, to John E. Borne, President of the Colonial Trust Co., New York, trustee. A sale under the first mortgage was made Feb. 6. (May 11, p. 312.)

PITTSBURGH, CINCINNATI, CHICAGO & ST. LOUIS.—Speyer & Co. and Kuhn, Loeb & Co., New York, are offering to holders of first consolidated mortgage 7 per cent. bonds of this company maturing Aug. 1 next the privilege of exchanging the same for the company's consolidated mortgage 3½ per cent. gold bonds, due 1949. The maturing bonds will be accepted on a 2½ per cent. basis, the computation to be as of May 15, which will give the holders of bonds, with August coupon attached, a new $1,000 bond and a cash payment of $19.46. Holders must surrender their bonds either to the above banks or to the Girard Trust Co., Philadelphia. The offer may terminate at any time without notice. (March 9, p. 162.)

PORT JERVIS, MONTICELLO & NEW YORK.—The New York, Ontario & Western in March, 1899, acquired a large amount of the securities of this road. The bonds are in default and the mortgage is being foreclosed to secure clear title. This line, in connection with the proposed Kingston & Rondout Valley, will give the company a through line from Port Jervis to Kingston, N. Y. (March 24, 1899, p. 220.)

QUEBEC & SOUTHERN.—An officer of the United Counties writes that it is expected that the Quebec & Southern will shortly be granted charter rights to acquire the property of the United Counties and of the East Richelieu Valley, which together form a line from Noyan Junction, Que., on the Canada Atlantic, and the Canadian end of the Rutland, RR., north to Sorel, on the St. Lawrence River. (May 4, p. 296.)

RIO GRANDE WESTERN.—Spencer Trask & Co., New York, have bought 7,000 shares of preferred stock at 90, less a banker's commission of 2½ per cent., which completes the limit of issue. The stock is offered to present holders to the extent of 4 per cent. of their holdings for subscription up to and including May 25 at 90. Applications for an amount in excess of the pro rata present holdings are to be given preference in the order of their receipt by the banks. All holders of under 25 shares will be secured in the right to subscribe for one share. Ten per cent. of the par value is to be paid upon application and the balance paid upon notification that the stock is ready for delivery. If the payment is made by May 31 the stock will carry the quarterly dividend of 1¼ per cent. due Aug. 1. The proceeds are to be used in part payment for expenditures made to change the gage and reduce the grade of the Utah Central, for important changes of grade and curvature on the main line, for further betterments on various lines and for additional equipment ordered since the last report to the stockholders. (May 4, p. 296.)

SAGINAW, TUSCOLA & HURON.—This company, which has been leased to the Pere Marquette, has filed a mortgage to the Continental Trust Co., New York, as trustee, to secure $1,000,000 4 per cent. bonds, guaranteed principal and interest by the Pere Marquette. (May 11, p. 312.)

SOUTHERN.—The stockholders on June 1 will vote as to the issue under the first consolidated mortgage of bonds at a rate less than 5 per cent., and on the acceptance of an amendment of the charter act of the General Assembly of Virginia, approved Jan. 23, 1900, permitting the reduction of the capital stock on the vote of a majority of the shares. (Jan. 12, p. 30.)

SOUTHERN PACIFIC.—Holders of first mortgage bonds are notified by the trustees that the sum of $400,000 is applicable for the redemption of these bonds and proposals will be received until noon June 12 at the company's land office, San Francisco. (March 9, p. 162.)

THIRD AVENUE (NEW YORK CITY).—The State Railroad Commission on May 14 approved the application of the company to issue a first consolidated mortgage bond for $50,000,000. (April 20, p. 264.)

TREDEGAR MINERAL.—Alabama press reports announce the sale of this property to the East & West of Alabama. The line runs from Jacksonville, Ala., to Tredegar Junction, four miles, and under the terms of the sale is to be completed to Anniston, Ala., about 12 miles. (Railroad Construction, March 16, p. 178.)

UNION TERMINAL.—This company is being organized to take over the property of the Sioux City Terminal, recently sold at foreclosure. (Sept. 1, 1899, p. 620.)

WISCONSIN CENTRAL.—Proposals will be received by the U. S. Trust Co., New York, or the Boston Safe Deposit & Trust Co., Boston, until June 5, for the sale to the sinking trust fund of consolidated mortgage bonds of Jan. 1, 1879, to the amount of $80,000. (May 11, p. 312.)

Specification issued by	Date of specification now in use.	Materials specified.	Process of manufacture specified.	Chemical properties.					Pound
				Carbon.	Manganese.	Silicon.	Phosphorus.	Sulphur.	Tensil strengt
United States Navy	Jan. 2, 1900.	Gun tubes.	Open-hearth.						78,00
"	"	" jackets.	" "						85,00
"	"	" hoops.	" "						95,00
"	"	" trunnion bands.	" "						95,00
"	"	" plugs.	" "						78,00
"	"	" mushrooms.	" "						78,00
"	1895.	Minor caliber rapid fire gun forgings.							87,00
"	June 19, 1899	Hull material, tillers, stem and stern posts.	Not specified.						60,00
"	"	" miscellaneous forgings.	" "						60,00
"	"	" blooms for misc. forgings made at smithy.	" "						58,00
"	May 19, 1899	Machinery material, high grade machinery forgings.	Open-hearth, nickel steel.				Not over .06	Not over .04	95,00
"	"	" " Class A, No. 1, machinery forgings.	" "				Not over .06	Not over .04	80,00
"	"	" " Class A, No 2. machinery forgings.	" carbon steel.				Not over .06	Not over .04	80,00
"	"	" " Class B, machinery forgings.	" nickel steel.				Not over .06	Not over .04	60,00
"	"	" " blooms and billets for forgings.	" carbon steel.				Not over .06	Not over .04	80,00
"	"	" " blooms and billets for forgings.					Not over .05	Not over .01	60,00
		" " forgings not essential to the structural strength of the engines and boilers.	Open-hearth or Bessemer soft steel. / Open-hearth or Bessemer medium steel.						52,000 t 62,000 / 60,000 t 70,000
"	Dec. 1, 1897.	Whitehead torpedo air flasks.	Open-hearth.						
United States Army	Sept. 17, 1896.	Tubes, field cannon of all calibers.	"						
"	"	" siege cannon of all calibers.	"						78,00
"	"	" seacoast cannon, 8-in. caliber and over.	"						78,00
"	"	" " " " "	Open-hearth, nickel steel.						78,00
"	"	Jackets, field cannon of all calibers.	Open-hearth.						85,00
"	"	" siege cannon of all calibers.	"						86,00
"	"	" seacoast cannon, 8-in. caliber.							86,00
"	"	" " " 8-in. caliber and over.	Open-hearth, nickel steel.						85,00
"	"	" " " 10-in. " "	Open-hearth.						90,00
"	"	Hoops, cylindrical, rough-finished size in forging:—							83,00
"	"	" not more than 11 in. inside diam., nor over 120 in. long. / " more than 11 in. inside diam.; not more than 24 in. inside diam.; not over 150 in. long.	Open-hearth.						90,00
"	"	" more than 24 in. inside diam.	" "						93,00
"	"	Trunnion hoops, field cannon of all calibers.	" "						90,00
"	"	" siege cannon of all calibers.	" "						90,00
"	"	" seacoast cannon of 8 in. caliber and over.	" "						90,00
"	"	Breech blocks, hinge pins, spindles and rollers, / Field and siege cannon of all cals.	" "						85,00
"	"	ditto. / seacoast cannon of 8-in. cal. and over.	" "						85,00
"	"	Lever handles, breech plates, face plates and block carriers. / field and siege cannon of all cals.	" "						75,00
"		ditto. / Seacoast cannon 8-in. cal. and over.	" "						75,00
"		Gas check cups and rings, bars for securing pins. / field and siege cannon, all cals.	" "						125,00
"	"	ditto. / seacoast cannon, 8 in. cal. and over.	" "						125,00
"	April 10 '99.	Gun carriage parts, forged steel No. 1.	Not specified.						60,00
"	"	" " " " " " 2.	" "						68,00
"	"	" " " " " " 3.	" "						90,00
United States Navy	May 18, 1898.	Armor plate bolts.	Open-hearth.						70,00
"	"	" nuts.	" "						78,00
U. S. Treasury—Engineer-in-Chief Revenue Cutter Service	1900.	Engines and machinery, Revenue Cutters, Nos. 7 & 8. / Shafting, steel columns, reverse shaft and crosshead slippers.	" "	{ Also all other miscellaneous forgings not shown on line next below.					60,00
		ditto. / Piston, connecting and eccentric rods valve stems, crossheads, and main links.	" "	{ Also connecting rod bolts, main bearing bolts, eccentric rod bolts and studs and link and valve stem bolts.					80,00
Wm. Cramp & Sons Ship & Eng. Bldg. Co	1899	Steel shafting for engines Nos. 198-201; 2 new boats for Int. Nav. Co	" "						60,00
ditto.	"	Pins for built up shafts, ditto.	" "						65,00
ditto.	"	Crank webs, ditto.	" "						60,00
ditto.	"	Cross heads, connecting and piston rods, ditto.	" "						65,00
ditto.	Aug. 17, 1898.	Engines for Russian cruiser and battleship. / Connecting rods and piston rods.	" "			†	Not over .06	Not over .04	80,00
ditto.	"	ditto. / Crossheads.	" "				Not over .06	Not over .04	65,00
ditto.	"	ditto. / Shafting.	" "				Not over .06	Not over .04	Upper e 62,720. Lower e 62,720
ditto.	"	ditto. / Reverse shafts and engine columns.	" "				Not over .06	Not over .04	62,72
ditto.	"	ditto. / Tie rods, miscellaneous forgings and blooms.	" "				Not over .06	Not over .04	62,72
American Bureau of Shipping	1899.	Crank, line or propeller shafts.	" "						58,00 Not ove
Bethlehem Steel Co		Standard shafting and machinery steel.	" "						68,00
ditto.		Standard nickel steel shafting.	Open-hearth nickel steel.				Not over .04	Not over .04	70,00
E. D Leavitt	1896.	Steel forgings.	"						80,00
ditto.	"	ditto.	"						
ditto.	"	ditto.	Open-hearth.						
Sprague Electric Co	"	Elevator bars.	"						
American Pulley Co	Aug. 9, 1899.	Forgings for 42 in. rim forming press.	Low phosphorus open-hearth.	Desired .30.			Not over .05		70,00
Winchester Repeating Arms Co	Dec. 3, 1896	Gun barrels.	Open-hearth, nickel steel.						
Lehigh Valley Railroad	Sep. 16, 1895.	Miscellaneous steel forgings.	Open-hearth.				Not over .06	Not over .06	80,00
Pensylvania Railroad	Aug. 15, 1893	Billets for main and parallel rods.							80,00
ditto.	Nov. 8, 1897.	Crank pin steel.		‡Desire .45.	{ Desire not over .60.	Desire not over .05.	Desire not over .03. Reject if over .05.	Desire not over .01.	80,00 Not ove
Philadelphia & Reading Railway	May 23, 1899	Steel crank pin forgings.							90,00
ditto.	"	Steel piston rods.							80,00
Erie Railroad	Feb. 1, 1899.	Miscellaneous forgings.	Open-hearth.				Not over .05	Not over .05	70,00
L. S. & M. S. Ry		Piston rods.	" "				Not over .05	Not over .05	80,00 Not ove 90,00
N. Y. C. & H. R. RR	Oct., 1899.	Steel forgings.	" "	Not over. .40 Not under .27	Not over .60		Not over .04	Not over .04	60,00 Not ove 70,00
B & O. RR	Sept. 1, 1898.	Crank pins.	" "	Not under .40			Not over .06	Not over .04	75,00 Not ove 85,00
ditto.	Aug. 1, 1896.	Main and parallel rods.	" "		Not over .60	§	Not over .05	Not over .04	85,00
Baldwin Locomotive Wks.	June 1, 1897.	Blooms for use in axles, pins, rods and other forgings.	" "	Desired .40	Not over .60	‖	Not over .05	Not over .05	70,00
Chicago & Northwestern RR	April 1, 1898.	Steel blooms for locomotive parallel rods.	" "						75,00 Not ove 90,00
Missouri, Kansas & Texas RR	Feb. 2, 1900.	Steel blooms for forgings.	" "						75,00
Southern Railway Co	Feb. 1, 1896.	Main, parallel and piston rods.					Not over .05		60,00
ditto.	May 9, 1896.	Crank pins.							70,00 Not ove 80,00
Chicago Burlington & Quincy RR	Feb. 20, 1897.	Side rods and piston rods.	Open-hearth.				Not over .05	Not over .05	85,00
ditto.	"	Crank pins.	" "	Not { over .40 under .25 }	Not over .65		Not over .05	Not over .05	70,00 Not ove 80,00
Norfolk & Western RR	Jan. 1, 1891.	Crank pins.		Not { over .45 under .30 }	Not over .65		Not over .05	Not over .05	75,00 Not ove 85,00
ditto.	April 25, 1891	Billets for rods and guides.							80,00
							Not over .05		80,00

* Quench test, 180° D = 2 T. † 3.25 per cent. of Nickel. ‡ Drillings will be taken with 5/8 in. drill

SYNOPSIS OF SPECIFICATIONS

COMPILED FOR COMMITTEE No. 1.—AMERICAN SECTION, INT

Chemical properties.					Minimum Physical properties required.					Bending test.	
					Pounds per sq. in.		Per cent.		Size of specimen.	Cold test.	Size of me
	Manganese.	Silicon.	Phosphorus.	Sulphur.	Tensile strength.	Elastic limit.	Elongation.	Contraction of area.			
....	....	.....	... .	....	78,000	40,000	20	35	2 in. x .5 in.	....	.....
....	....	... .	....	....	85,000	43,000	18	30	"	.....	.....
....	....	....	....	....	95,000	50,000	18	30	"	.....	.....
....	.....	....	....	....	95,000	50,000	18	30	"	.....	....
....	.....	... .	....	....	78,000	40 000	18	30	"	. ...	.....
....	....	.....	....	....	78,000	40 000	20	35	"	....	.....
....	....	.....	....	....	87,000	45,000	{ T = 17 L = 20 }	....	"	.....	.....
....	....	.....	....	....	60.000	.....	30	.....	"	Flat.	½ di
....	....	.....	....	....	60.000	.....	30	.....	"	"	"
....	....	.....	....	....	58,000	....	28	.....	"	"	"
....	....	....	Not over .06	Not over .04	95,000	65,000	21	.....	"	180° D = 2T	1 in. x
....	... .	.....	Not over .06	Not over .04	80,000	50,000	25	.....	"	180° D = 2T	"
....	....	.....	Not over .06	Not over .04	80,000	45,000	26	.....	"	180° D = T	"
....	....	.....	Not over .06	Not over .04	60,000	30,000	30	.....	"	180° D = T	"
..	....	.....	Not over .06	Not over .04	80 000	50,000	24	.. ..	"	180° D = 2T	"
....	....	.....	Not over .05	Not over .01	60,000	30,000	26	. .....	"	180° D = T	"
....	....	.....	....	....	{ 52,000 to 62,000	{ 26,000 to 31.000	25	....	8 in. x 1.5 in.	Flat.	.....
....	....	.....	....	....	{ 60,000 to 70,000	{ 30,000 to 35, 00	22	....		180° D = T	.....
....	.....	.....	....	....	.....	68,000	11	.....	2 in. x .5 in.	.. ..	.....
....	.....	.....	....	....	78,000	42,000	20	35	2 in. x .505 in.	....	... ...
....	....	....	....	....	78 000	42 000	18	30	2 in. x .505 in.	.....	.... .
.	....	.....	....	....	78,000	42 000	17	30	3 in. x .564 in.	....	.....
....	....	.....	....	....	85.000	53,000	18	35	3 in. x .564 in.	....	.....
....	....	.....	....	....	86.000	46.000	17	30	2 in. x .505 in.	....	.....
....	....	....	....	....	86,000	46,000	16	27	3 in. x .564 in.	....	.....
....	. ...	.. ..	....	....	85,000	46,000	16	27	3 in. x .564 in.	....	.... .
....	....	.....	....	....	90 000	55.000	17	32.50	3 in. x .564 in.	....	.....
....	....	.....	....	....	83,000	44,000	16	27	3 in. x .564 in.	....	.....
....	....	.....	....	....	90 000	50 000	18	.....	2 in. x .505 in.	....	.....
....	....	.....	....	....	93,000	53,000	15	.....	3 in. x .564 in.	....	.....
....	....	.....	....	....	93,000	53,000	13	....	4 in. x .564 in.	.....	.....
....	....	.....	....	....	90 000	50,000	18	.....	2 in. x .505 in.	.....	.....
....	....	.....	....	....	90,000	50,000	15	.....	3 in. x .564 in.	.....	.....
....	....	.....	....	....	90,000	50,000	13	.....	4 in. x .564 in.	.....	.....
....	....	.....	....	....	85,000	45,000	18	.....	2 in. x .505 in.	.....	.....
....	....	.....	....	....	85,000	45,000	16	.....	3 in. x .564 in.	.....	.....
....	....	.....	....	....	75,000	40,000	20	.....	2 in. x .505 in.	.....	.....
....	....	.....	....	....	75,000	40,000	18	.....	3 in. x .564 in.	.....	.....
....	....	.....	....	....	125,000	75,000	12	.....	2 in. x .505 in.	.....	.....
....	....	.....	....	....	125,000	75,000	10	.....	3 in. x .564 in.	.....	.....
....	....	.....	....	....	60,000	.....	28	.....	2 in. x .505 in.	.....	.....
....	....	.....	....	....	68,000	.....	22	.....	2 in. x .505 in.	.....	.....
....	....	.....	....	....	90.000	.....	16	27	2 in. x .505 in.	.....	.....
....	....	.....	....	....	70.000	.... ..	25	....	2 in. x .5 in.	.....	.....
....	....	.....	....	....	78.000	... .	15	.....	2 in. x .5 in.	.....	.....
	ther miscellaneous forgings not shown on line next below.				60,000	.....	{ See remarks. } 30	.. ..	2 in. x .798 in.	Flat.	1 in. x ½
	necting rod bolts, main bearing bolts, eccentric rod bolts and studs and link and valve stem bolts.				80.000	....	26	... .	⅞ in. x .798 in.	180° D = 2T	½ in. d
....	....	.....	....	....	60,000	.....	In 2 in. 26.	....	....	180° D = 3T	½ in. di
....	....	.....	....	....	65,000	.....	In 2 in. 25.	....	....	"	"
....	....	.....	....	....	60,000	.....	In 2 in. 26.	....	.....	"	"
....	....	....	....	. . ..	65,000	35,000	In 2 in. 25.	....	....	"	Longitud
....	....	†	Not over .06	Not over .04	80,000	45,000	In 2 in. 23.	{ See remarks. }	.....	180° D = ⅝ in.	{ 1 in. sc longitu
....	....	....	Not over .06	Not over .04	65,000	.....	In 2 in. 25.	....	.....	"	"
....	....	..... .	Not over .06	Not over .04	{ Upper end 62,720. Lower end 62,720	{ 25,000 35,000	{ In 2 in. 26 In 2 in. 24	....	....	"	"
....	....	....	Not over .06	Not over .04	62,720	.....	In 2 in. 25.	.....	.....	"	"
....	....	.....	Not over .06	Not over .04	62,720	.....	In 2 in. 24	.....	....	.....	.....
....	... .	....	.....	.....	{ 58,000 Not over 68,000	.....	{ 20 25 }	....	{ 8 in. long. 4 in. long. }	.....	.....
....	.....	.....	Not over .04	Not over .04	70,000	35,000	25	....	2 in. x .5 in.	.....	.....
....	.....	.....	.....	.....	80,000	45,000	25	....	"	.....	.....
....	....	.....	.....	.....	.....	50,000	18	.....	10 in.	....	.....
....	....	.....	.....	.. ..	..... .	45,000	18	....	10 in.	.....	.....
....	....	.....	.....	....	.....	45,000	18	.....	10 in.	....	.....
....	....	.....	.....	....	.....	80,000	.....	.....	.....	.....	.....
30.	... .	....	Not over .05	.....	70,000	.....	In 8 in. 25	... .	.....	.....	.....
..	....	.....	.....	.....	.....	80,000	20	.....	2 in. x .5 in.	.....	.....
....	.....	....	Not over .06	Not over .06	80,000	.....	17	.....	2 in. x .625 in.	.....	.....
..	.....	.....	.....	.....	80,000	.....	12	....	2 in. x .625 in.	.....	.....
5.	{ Desire not over .60.	Desire not over .05.	Desire not over .03. Reject if over .05.	Desire not over .04.	{ 80,000 Not over 90,000	.....	12	.....	8 in. long.	.....	.....
....	.....	.....	.....	.....	.....	.. ..	In 2 in. 15.	....	{ .5 in. sq. x 3 in. bet shoulders.	.....	.....
..	.....	.....	.....	.....	.....	.....	In 2 in. 25.	.....	{ .5 in. sq. x 3 in. bet. shoulders.	.....	.....
..	.....	.....	.....	.....	{ 80,000 Not over 90,000	.....	In 2 in. 17.	... .	2 in. x .875 in.	.....	.....
....	.....	.....	.....	.....	{ 60,000 Not over 70,000	.....	In 8 in. 22.	.....	.. ..	.....	.....
.40 .27	Not over .60	....	Not over .04	Not over .04	{ 75,000 Not over 85,000	.....	In 2 in. 20.	....	....	.....	.....
.40	....	.....	Not over .06	Not over .04	85,000	....	{ In 2 in. 15. See remarks. }	....	2.5 in. x .5 in.	....	.....
..	Not over .60	§	Not over .05	Not over .04	70,000	.....	In 2 in. 20	.....	2.5 in. x .5 in.	.....	.....
0	Not over .60	‖	Not over .05	Not over .05	{ 75,000 Not over 90,000	. ....	In 2 in. 15	....	2 in. x .875 in.	. .....	.....
	....	....	....	.....	75,000	.....	In 8 in. 18	.....	8.5 in. x .625 in	....	.....
....	... .	....	Not over .05	....	60,000	.....	In 2 in. 15.	.....	....	....	.....
....	.....	.....	.....	....	{ 70,000 Not over 80,000	...	In 2 in. 20.	.....	2.5 in. x .5 in.	.. ..	.....
....	.....	.....	Not over .05	....	85,000	....	In 2 in. 15.	....	2.5 in. x .5 in.	....	....
.49 .25	Not over .65	.. ..	Not over .05	Not over .05	{ 70,000 Not over 80,000	.....	In 4 in. 22	....	4.5 in. x .625 in.	.. ..	.....
.45 .20	Not over .65	....	Not over .05	Not over .05	{ 75,000 Not over 85,000	.....	In 4 in. 20	.....	4.5 in. x .625 in.	.....	.....
..	.....	.....	.....	....	80,000	....	12	....	2 in x .625 in.	.....	.....
..	.....	.....	Not over .05	.....	80,000	....	15	.....	2 in. x. .625 in.	.....	.. ..

3 25 per cent. of Nickel.

‡ Drillings will be taken with ⅝ in. drill 40% of distance out from centre of pin, from either end of a pin, selecte l at random fro

FICATIONS FOR STEEL FORGINGS.

SECTION, INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

ding test. Size of specimen.	Treatment specified.	Finish.	Inspection.	Number and location of tensile tests specified.
	Annealed, oil-tempered and annealed.	As per drawing. To be free from slag, seams, cracks, cavities, flaws, blow holes, unsoundness, foreign substances and all other defects affecting their resistance and value.	Inspector to have free access to all parts of the works where material is being manufactured.	Transverse. Yes.
	"	ditto.	ditto.	" "
	"	ditto.	ditto.	" "
	"	ditto.	ditto.	" "
	"	ditto.	ditto.	Transverse and longitudinal. Yes.
	"	ditto.	ditto.	Transverse, also longitudinal for elongation. Yes.
½ diam.	None specified.	To drawing, free from all defects.	ditto.	Longitudinal. Yes.
"	" "	ditto.	ditto.	" "
"	" "	ditto.	ditto.	" "
1 in. x ½ in.	Oil-tempered & annealed optional.	To be free from slag, cracks, blowholes, hard spots, sand, foreign substances, and all other defects affecting their value. To drawing.	ditto.	" "
"	Annealed.	ditto.	ditto.	" "
"	"	ditto.	ditto.	" "
"	May be annealed.	ditto.	ditto.	" "
"	"	ditto.	ditto.	" "
	None specified.	ditto.	ditto.	" No.
	"	ditto.	ditto.	" "
	Oil-tempered and annealed.	To drawing. To be free from slag, seams, cracks, cavities, flaws, blowholes, unsoundness, foreign substances and all other defects affecting their resistance and value.	ditto.	Transverse. Yes.
	Annealed, oil-tempered and annealed.	To drawing and free from seams, cracks and slag, folds or other defects.	ditto.	Tangential. "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	" "
	ditto.	ditto.	ditto.	Tangential where possible, otherwise longitudinal.
	ditto.	ditto.	ditto.	ditto.
	ditto.	ditto.	ditto.	ditto.
	ditto.	ditto.	ditto.	ditto.
	ditto.	ditto.	ditto.	ditto.
	ditto.	ditto.	ditto.	ditto.
	Annealed, at a temperature of at least 1100° F.	To be sound, of uniform quality and condition, and free from seams, cracks or other defects.	ditto.	Longitudinal. Yes.
	Oil-tempered and annealed.	Free from imperfections of manufacture, and from such cracks, cavities, flaws, slag, sand spots, cinders, etc, as would diminish their resistance or value.	ditto.	" "
			ditto.	" "
1 in. x ½ in.	Annealed.	All steel forgings to be without welds and free from defects.	Every facility shall be extended to the inspector for testing and examining the material in course of manufacture at the mill.	" "
½ in. diam.	"	Sound, free from defects.	Subject to inspection at any stage of progress and further tests may be demanded.	Tensile specimens from each end of each forging.
½ in. diam.			ditto.	ditto.
"		"	ditto.	Transverse specimens from each end of each web.
"		"	ditto.	Longitudinal from each head of connecting rods and each end of piston rods.
Longitudinal.		"		Longitudinal from each end.
1 in. square longitudinal.	Oil-tempered and annealed.	Free from slag, cracks, blowholes, hard spots, sand, foreign substances and all other defects.	Russian Navy Inspector to have free access to all parts of the works during progress of manufacture.	ditto.
"		ditto.	ditto.	Piece to be cut from each end of each forging for longitudinal tests. Four test pieces to taken from the end which was nearest the top of the ingot, two of which shall be taken f the outside and two midway between center and radius. Two test pieces to be taken f the lower end of the forging midway between center and radius.
"		ditto.	ditto.	
		ditto.	ditto.	
			To be carefully examined after being turned.	To be cut cold.
	Oil-tempered. Annealed. Oil-tempered.			
		Free from flaws and seams and of best grade of forgings for machine construction.	Inspector to have access to the shops where work is being done for purposes of inspection.	Small forged test bars of same heat.
	Annealed	Sound throughout, free from piping and surface imperfections.	Inspector at steel works to see that conditions of this specification are complied with.	Longitudinal. To be machined cold and taken half-way between central axis and out from full-sized prolongation. Test piece to be cut from upper end of upper bloom in ingo
				One billet from each lot of 25 or less, to have piece drawn from it under the hammer turned to size for tests.
				Two from any part of one pin selected at random from each lot of 50, centre line of pieces not to be nearer than 1 in. to centre line of pin.
		Free from physical defects before and after working.	Fractured ends of test pieces to be free from coarse granular appearance.	Longitudinal to be taken not less than 1½ in. from centre of a pin to be selected at rand from each lot of 50 or less.
		ditto.	ditto.	Longitudinal taken midway between central axis and outside of one rod selected at r dom from each lot of 25 or less.
				Each test specimen to be machined cold, longitudinally taken from a prolonged portio forging, midway between center axis and surface.
		Ingots for forgings to be free from pipes, segregation and like imperfections.		
			Will be inspected and tested on its arrival at destination.	Two tests cut from pin of each heat, cut midway between center and edge.
				Two tests cut from one rod from each heat, cut midway between center and edge.
		Free from seams, slivers and other surface defects.		Test piece to be machined cold from full-sized bloom of each heat.
		To be free from cracks, flaws, and defects of all kinds.	Manufacturer to furnish test apparatus and assistance when inspection is at mfrs. works. Small lots inspected at destination.	One end of each bloom must be drawn to a test piece 2 inches square by 18 inches lo to remain attached until bloom is inspected; a tensile test specimen is to be cut from t bar, midway between centre and outside.
				Test piece cut from forging four inches in diameter, hammered from bloom and allow to cool.
		To be free from cracks, flaws and seams.	Manufacturer to furnish test apparatus and assistance to inspector free.	One rod from each heat must be 6 inches extra long, and from this two test pie will be cut.
		ditto.	ditto.	One pin from each heat will have two test pieces cut from it.
				One end of each billet to be drawn down to a test bar 2 inches square and 10 inc long, to remain on the billet; a tensile test specimen will be cut from the bar, midw between centre and outside.
				ditto.
				One ingot selected at random from each lot of 51 shall have two test specimens c from any part of it, provided centre line of test pieces falls one and one-half inch from center line of ingot.
				One billet from each shipment will have a piece drawn from it under the hamm about two inches square by 12 inches long, from which tensile test specimen will turned down.

at random from each lot of 50, drilling to be parallel to the axis of the pin. § Check analysis from test piece. ‖ To be analyzed by Baldwin Loco. Works. Drillings taken midway between center and surface.

SYNOPSIS OF SPECIFICATIONS FOR STEEL FORGINGS.

COMPILED FOR COMMITTEE No. 1.—AMERICAN SECTION, INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

Sulphur.	Minimum Physical properties required.					Bending test.		Treatment specified.	Finish.	
	Pounds per sq. in.		Per cent.		Size of specimen.	Cold test.	Size of specimen.			
	Tensile strength.	Elastic limit.	Elongation.	Contraction of area.						
.....	78,000	40,000	20	35	2 in. x .5 in.	.....	.....	Annealed, oil-tempered and annealed.	As per drawing. To be free from slag, seams, cracks, cavities, flaws, blow holes, unsoundness, foreign substances and all other defects affecting their resistance and value.	Inspector to hs the works wh factured.
.....	85,000	43,000	18	30	"	.....	.....	"		
.....	95,000	50,000	18	30	"	.....	.....	"		
.....	95,000	50,000	18	30	"	.....	.....	"		
.....	78,000	40 000	18	30	"	.....	.....	"	ditto.	
.....	78,000	40 000	20	35	"	.....	.....	"	ditto.	
.....	87,000	45,000	T = 17 L = 20	.....	"	.....	.....	"	ditto.	
.....	60,000	.....	30	.....	"	Flat.	½ diam.	None specified.	To drawing, free from all defects.	
.....	60,000	.....	30	.....	"	"	"	" "	ditto.	
.....	58,000	.....	28	.....	"	"	"	" "	ditto.	
Not over .01	95,000	65,000	21	.....	"	180° D = 2T	1 in. x ½ in.	Oil-tempered & annealed	To be free from slag, cracks, blowholes, hard spots, sand, foreign substances, and all other defects affecting their value. To drawing.	
Not over .01	80,000	50,000	25	.....	"	180° D = 2T	"	" optional.		
Not over .01	80,000	45,000	26	.....	"	180° D = T	"	Annealed.		
Not over .01	60,000	30,000	30	.....	"	180° D = T	"	"	ditto.	
Not over .01	80 000	50,000	24	.....	"	180° D = 2T	"	May be annealed.	ditto.	
Not over .01	60,000	30,000	26	.....	"	180° D = T	"	"	ditto.	
.....	52,000 to 62,000	26,000 to 31,000	25	.....	8 in. x 1.5 in.	Flat.	.....	None specified.	ditto.	
.....	60,000 to 70,000	30,000 to 35, 00	22	.....	"	180° D = T	.....	"	ditto.	
.....	.....	68,000	14	.....	2 in. x .5 in.	.....	.....	Oil-tempered and annealed.	To drawing. To be free from slag, seams, cracks, cavities, flaws, blowholes, unsoundness, foreign substances and all other defects affecting their resistance and value.	
.....	78,000	42,000	20	35	2 in. x .505 in.	.....	.....	Annealed, oil-tempered and annealed.	To drawing and free from seams, cracks and slag, folds or other defects.	
.....	78 000	42 000	18	30	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	78,000	42 000	17	30	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	85,000	53,000	18	35	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	86,000	46,000	17	30	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	86,000	46,000	16	27	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	85,000	46,000	16	27	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	90 000	55,000	17	32.50	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	83,000	44,000	16	27	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	90 000	50 000	18	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	93,000	53,000	15	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	93,000	53,000	13	.....	4 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	90 000	50,000	18	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	90,000	50,000	15	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	90,000	50,000	13	.....	4 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	85,000	45,000	18	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	85,000	45,000	16	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	75,000	40,000	20	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	75,000	40,000	18	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	125,000	75,000	12	.....	2 in. x .505 in.	.....	.....	ditto.	ditto.	
.....	125,000	75,000	10	.....	3 in. x .564 in.	.....	.....	ditto.	ditto.	
.....	60,000	.....	28	.....	2 in. x .505 in.	.....	.....	Annealed, at a temperature of at least 1100° F.	To be sound, of uniform quality and condition, and free from seams, cracks or other defects.	
.....	68,000	.....	22	.....	2 in. x .505 in.	.....	.....	"	ditto.	
.....	90,000	.....	16	27	2 in. x .505 in.	.....	.....	Oil-tempered and annealed.	Free from imperfections of manufacture, and from such cracks, cavities, flaws, slag, sand spots, cinders, etc , as would diminish their resistance or value.	
.....	70,000	.....	25	.....	2 in. x .5 in.	.....	.....	"	All steel forgings to be without welds and free from defects.	Every facility sha for testing and course of manuf
.....	78,000	.....	15	.....	2 in. x .5 in.	.....	.....	"	Sound, free from defects.	Subject to inspect and further test
Bolts and studs	60,000	.....	See remarks.	30	2 in. x .798 in.	Flat.	1 in. x ½ in.	Annealed.	"	
Bolts and studs	80,000	.....	26	.....	" in. x .798 in.	180° D = 2T	½ in. diam.	"	"	
.....	60,000	.....	In 2 in. 26.	.....	.....	180° D = 3T	½ in. diam.	.....	"	
.....	65,000	.....	In 2 in. 25.	.....	.....	"	"	.....	"	
.....	60,000	.....	In 2 in. 26.	.....	.....	"	"	.....	"	
.....	65,000	35,000	In 2 in. 25.	.....	.....	"	Longitudinal.	.....	"	
Not over .04	80,000	45,000	In 2 in. 23.	See remarks.	.....	180° D = 5/8 in.	1 in. square longitudinal.	Oil-tempered and annealed.	Free from slag, cracks, blowholes, hard spots, sand, foreign substances and all other defects.	Russian Navy I all parts of the o
Not over .04	65,000	.....	In 2 in. 25.	.....	.....	"	"	.....	ditto.	
Not over .04	Upper end 62,720. Lower end 62,720	25,000 35,000	In 2 in. 26 In 2 in. 24	.....	.....	"	"	.....	ditto.	
Not over .04	62,720	.....	In 2 in. 25.	.....	.....	"	"	.....	ditto.	
Not over .04	62,720	.....	In 2 in. 24	.....	.....	.....	.....	.....	ditto.	
.....	58,000 Not over 68,000	.....	20 25	.....	8 in. long. 4 in. long.	.....	.....	.....	.....	To be carefully ex
Not over .04	70,000	35,000	25	.....	2 in. x .5 in.	.....	.....	.....	.....	
.....	80,000	45,000	25	.....	"	.....	.....	.....	.....	
.....	.....	50,000	18	.....	10 in.	.....	.....	Oil-tempered.	.....	
.....	.....	45,000	18	.....	10 in.	.....	.....	Annealed.	.....	
.....	.....	45,000	18	.....	10 in.	.....	.....	Oil-tempered.	.....	
.....	.....	80,000	.....	.....	.....	.....	.....	.....	.....	
.....	70,000	.....	In 8 in. 25	.....	.....	.....	.....	.....	Free from flaws and seams and of best grade of forgings for machine construction.	Inspector to have is being done fo
.....	.....	80,000	20	.....	2 in. x 5 in.	.....	.....	.....	.....	
Not over .06	80,000	.....	17	.....	2 in. x .625 in.	.....	.....	Annealed	Sound throughout, free from piping and surface imperfections.	Inspector at steel v of this specificati
.....	80,000	.....	12	.....	2 in. x .625 in.	.....	.....	.....	.....	.....
Desire not over .04.	80,000 Not over 90,000	.....	12	.....	8 in. long.	.....	.....	.....	.....	.....
.....	80,000	.....	In 2 in. 15.	.....	5 in. sq. x 3 in. bet shoulders.	.....	.....	.....	Free from physical defects before and after working.	Fractured ends o coarse granular
.....	70,000	.....	In 2 in. 25.	.....	5 in. sq. x 3 in. bet. shoulders.	.....	.....	.....	ditto.	
Not over .05	80,000 Not over 90,000	.....	In 2 in. 17.	.....	2 in. x .875 in.	.....	.....	.....	.....	.....
Not over .05	60,000 Not over 70,000	.....	In 8 in. 22.	.....	.....	.....	.....	.....	.....	.....
Not over .04	75,000 Not over 85,000	.....	In 2 in. 20.	.....	.....	.....	.....	.....	Ingots for forgings to be free from pipes, segregation and like imperfections.	.....
Not over .04	85,000	.....	In 2 in. 15. See remarks.	.....	2.5 in. x .5 in.	.....	.....	.....	.....	Will be inspected destination.
Not over .04	70,000	.....	In 2 in. 20	.....	2.5 in. x .5 in.	.....	.....	.....	.....	.....
Not over .05	75,000 Not over 90,000	.....	In 2 in. 15	.....	2 in. x .875 in.	.....	.....	.....	Free from seams, slivers and other surface defects.	.....
.....	75,000	.....	In 8 in. 18	.....	8.5 in. x .625 in	.....	.....	.....	To be free from cracks, flaws, and defects of all kinds.	Manufacturer to assistance when Small lots inspec
.....	60,000	.....	In 2 in. 15.	.....	.....	.....	.....	.....	.....	.....
.....	70,000 Not over 80,000	.....	In 2 in. 20.	.....	2.5 in. x .5 in.	.....	.....	.....	To be free from cracks, flaws and seams.	Manufacturer to assistance to ins
.....	85,000	.....	In 2 in. 15.	.....	2.5 in. x .5 in.	.....	.....	.....	ditto.	
Not over .05	70,000 Not over 80,000	.....	In 4 in. 22	.....	4.5 in. x .625 in.	.....	.....	.....	.....	.....
Not over .05	75,000 Not over 85,000	.....	In 4 in. 20	.....	4.5 in. x .625 in.	.....	.....	.....	.....	.....
.....	80,000	.....	12	.....	2 in x .625 in.	.....	.....	.....	.....	.....
.....	80,000	.....	15	.....	2 in. x. .625 in.	.....	.....	.....	.....	.....

...ken with 5/8 in. drill 40% of distance out from centre of pin, from either end of a pin, selected at random from each lot of 50, drilling to be parallel to the axis of the pin. § Check analysis from test piece. ‖ To be

Inspection.	Number and location of tensile tests specified.	Percentage of top & bottom discard from ingots specf'd.	A certain reduction in forging specified.	Remarks.
Inspector to have free access to all parts of the works where material is being manufactured.	Transverse. Yes.	Yes.	Yes.	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	Transverse and longitudinal. Yes.	"	"	
ditto.	Transverse, also longitudinal for elongation. Yes.	"	No.	
ditto.	Longitudinal. Yes.	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" No.	No.	"	
ditto.	" "	"	"	
ditto.	Transverse. Yes.	Yes.	Yes.	
ditto.	Tangential. "	"	"	Specification calls for powder and hydraulic tests.
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	No.	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	Tangential where possible, otherwise longitudinal.	"	"	
ditto.	ditto.	"	"	
ditto.	ditto.	"	"	
ditto.	ditto.	"	"	
ditto.	ditto.	"	"	
ditto.	ditto.	"	"	
ditto.	ditto.	"	"	
ditto.	Longitudinal. Yes.	No.	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
ditto.	" "	"	"	
Any facility shall be extended to the inspector for testing and examining the material in course of manufacture at the mill.	" "	Yes, top.	"	For specimens taken between crank webs, 28.00 per cent. elongation.
Subject to inspection at any stage of progress and further tests may be demanded.	Tensile specimens from each end of each forging.	No.	No.	
ditto.	ditto.	"	"	
ditto.	Transverse specimens from each end of each web.	"	"	
ditto.	Longitudinal from each head of connecting rods and each end of piston rods.	"	"	
Russian Navy Inspector to have free access to all parts of the works during progress of manufacture.	Longitudinal from each end.	Yes	No.	Elongation to average 25 per cent.
	ditto.	"	"	
ditto.	Piece to be cut from each end of each forging for longitudinal tests. Four test pieces to be taken from the end which was nearest the top of the ingot, two of which shall be taken from the outside and two midway between center and radius. Two test pieces to be taken from the lower end of the forging midway between center and radius.	"	"	
ditto.	.....	"	"	
ditto.	.....	"	"	
Are carefully examined after being turned.	To be cut cold.	.....	.....	
Inspector to have access to the shops where work is being done for purposes of inspection.	Small forged test bars of same heat.	No.	No.	
Inspector at steel works to see that conditions of this specification are complied with.	Longitudinal. To be machined cold and taken half-way between central axis and outside from full-sized prolongation. Test piece to be cut from upper end of upper bloom in ingot.	Yes. top.	No	
.....	One billet from each lot of 25 or less, to have piece drawn from it under the hammer and turned to size for tests.	No.	"	
.....	Two from any part of one pin selected at random from each lot of 50, centre line of test pieces not to be nearer than 1 in. to centre line of pin.	"	"	If two tensile tests of one order differ over 5,000 pounds or over 5 per cent. in elongation, the order is rejected.
Fractured ends of test pieces to be free from coarse granular appearance.	Longitudinal to be taken not less than 1½ in. from centre of a pin to be selected at random from each lot of 50 or less.	"	"	
ditto.	Longitudinal taken midway between central axis and outside of one rod selected at random from each lot of 25 or less.	"	"	
.....	Each test specimen to be machined cold, longitudinally taken from a prolonged portion of forging, midway between center axis and surface.	Yes, top.	No.	
.....	.....	No.	"	
.....	.....	"	"	
Will be inspected and tested on its arrival at destination.	Two tests cut from pin of each heat, cut midway between center and edge.	"	"	As many pins as possible to be made from a heat. Elongation may be 12 50% if T.S. is above 90,000 pounds.
.....	Two tests cut from one rod from each heat, cut midway between center and edge.	"	"	As many rods as possible to be made from a heat.
.....	Test piece to be machined cold from full-sized bloom of each heat.	"	"	No chipping permitted for the removal of defects except as authorized by inspector.
Manufacturer to furnish test apparatus and assistance when inspection is at mfrs. works. Of all lots inspected at destination.	One end of each bloom must be drawn to a test piece 2 inches square by 18 inches long, to remain attached until bloom is inspected; a tensile test specimen is to be cut from this bar, midway between centre and outside.	No.	No.	
.....	Test piece cut from forging four inches in diameter, hammered from bloom and allowed to cool.	"	"	
Manufacturer to furnish test apparatus and assistance to inspector free.	One rod from each heat must be 6 inches extra long, and from this two test pieces will be cut.	"	"	Rods to be made from as few heats as possible.
ditto.	One pin from each heat will have two test pieces cut from it.	"	"	As many pins as possible from each heat.
.....	One end of each billet to be drawn down to a test bar 2 inches square and 10 inches long, to remain on the billet; a tensile test specimen will be cut from the bar, midway between centre and outside.	"	"	
.....	ditto.	"	"	
.....	One ingot selected at random from each lot of 51 shall have two test specimens cut from any part of it, provided centre line of test pieces falls one and one-half inches from center line of ingot.	"	"	
.....	One billet from each shipment will have a piece drawn from it under the hammer about two inches square by 12 inches long, from which tensile test specimen will be turned down.	"	"	

ce. ‖ To be analyzed by Baldwin Loco. Works. Drillings taken midway between center and surface.